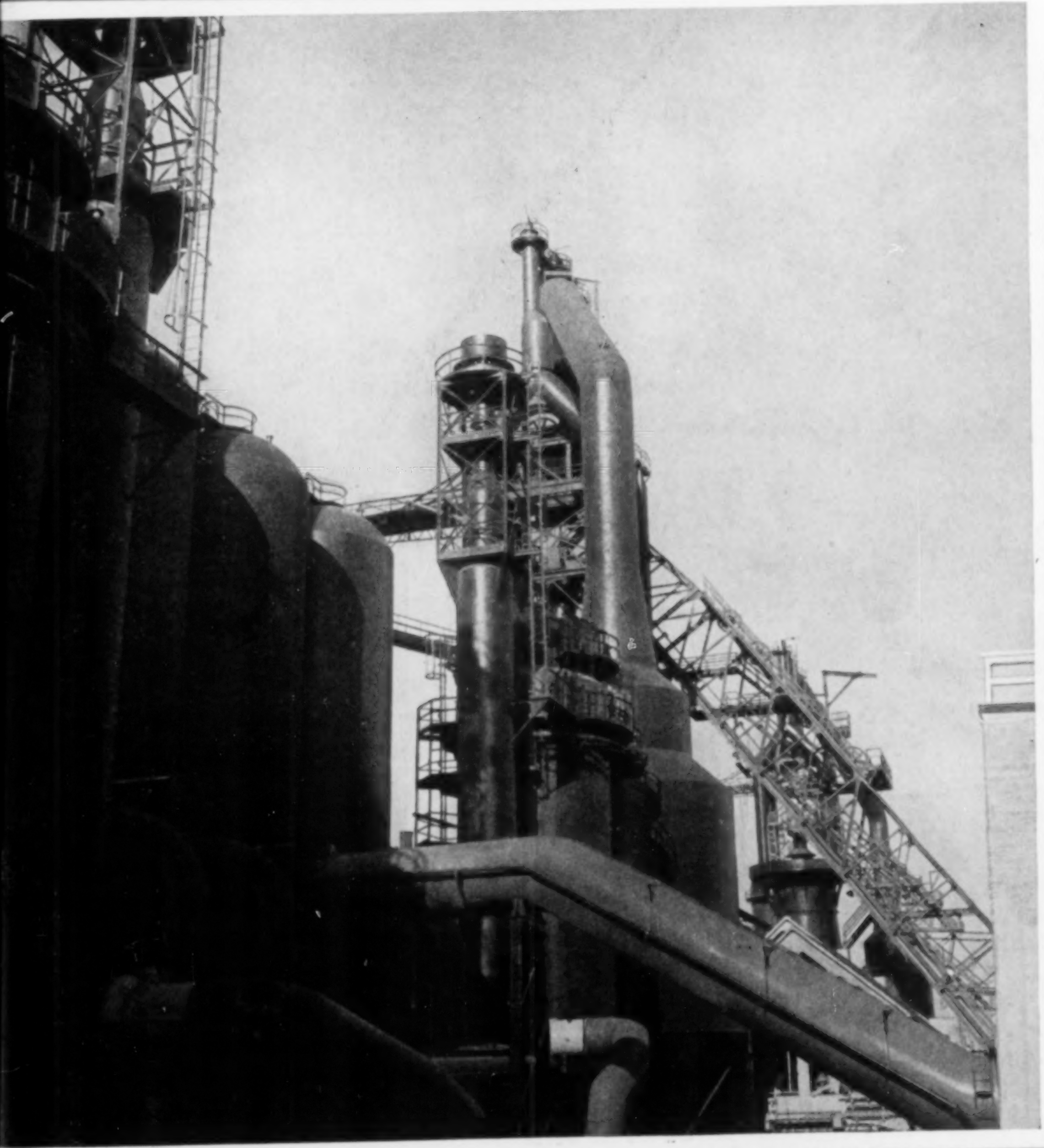
Compressed Air
Magazine

FEBRUARY 1944



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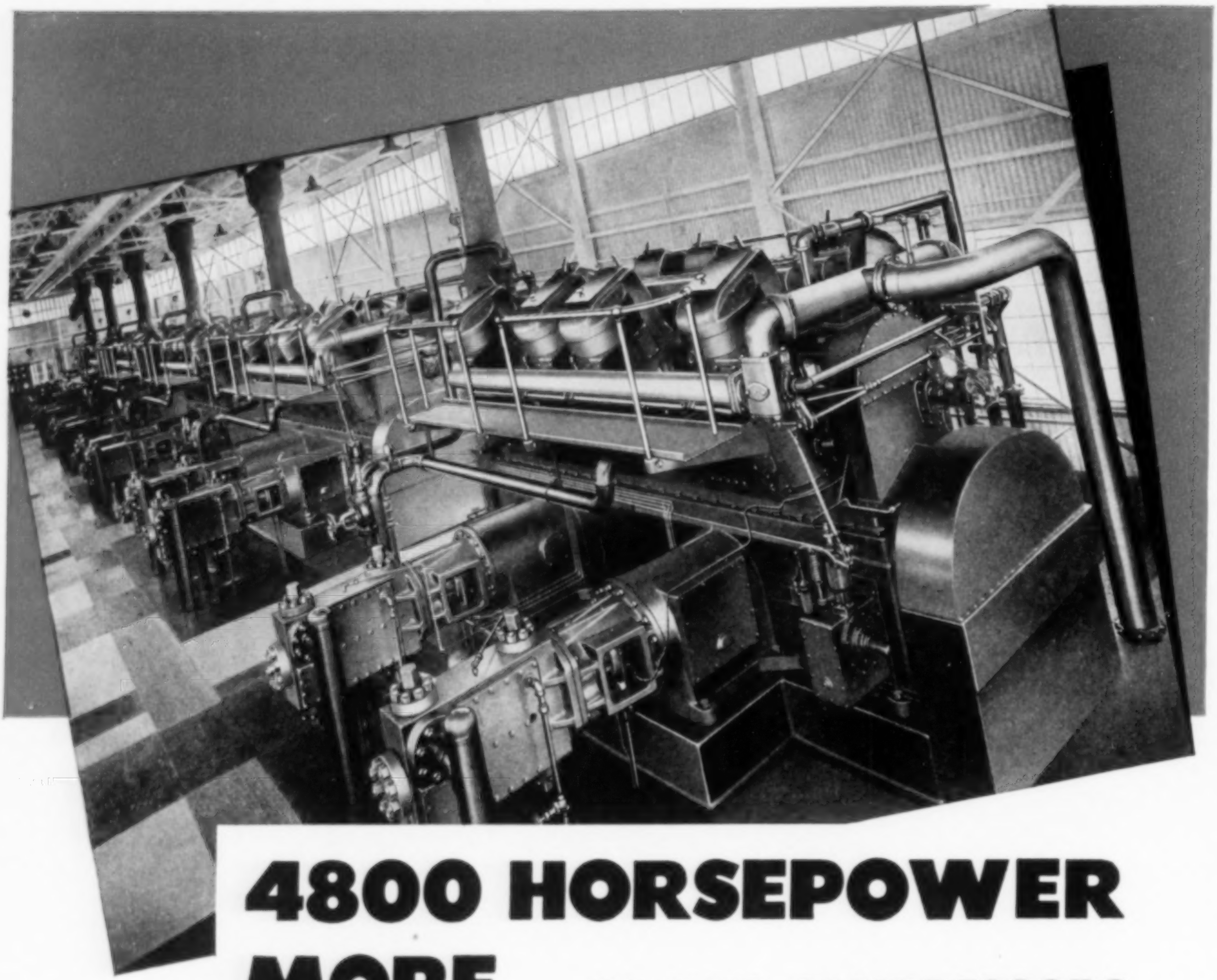
BLAST FURNACE AT GENEVA

No. 2 unit at new Utah steel plant.

●

VOLUME 49 • NUMBER 2

NEW YORK • LONDON



4800 HORSEPOWER MORE . . . OF KVG COMPRESSORS

4-CYCLE
V-ANGLE DESIGN

Here is more evidence of the part Ingersoll-Rand gas-engine compressors are playing in the petroleum industry's tremendous expansion and conservation program.

Five of these units are KVG single-stage compressors operating at 1500-lb suction and 4100-lb discharge on recycling service. The other KVG unit — a three-stage compressor — operates at 1500-lb discharge.

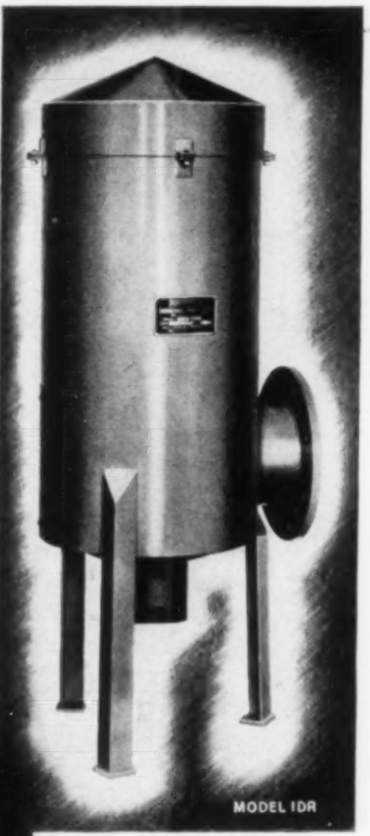
The KVG is the newest and largest of Ingersoll-Rand's line of 4-cycle, V-angle gas-engine compressors which 12 years ago changed the whole trend in the design of compressors for oil-field and refinery service. When you need compressors, the enviable records of these machines during the past decade are worth your consideration.

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

6-395

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

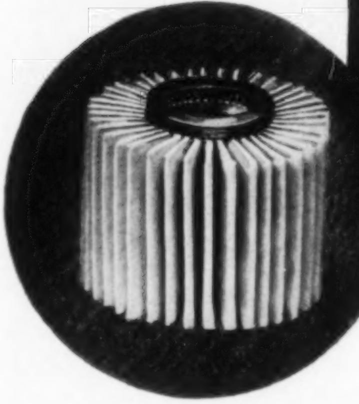
new STAYNEW Intake Air Filter



ALL THE CONVENIENCE OF GROUND LEVEL INSTALLATION

ALL THE EFFICIENCY OF HIGH LEVEL AIR INTAKE

NOW you can equip compressors and internal combustion engines with a Staynew filter providing all the recognized advantages of the famous Protectomotor line . . . *plus* an exclusive combination of two new features . . .

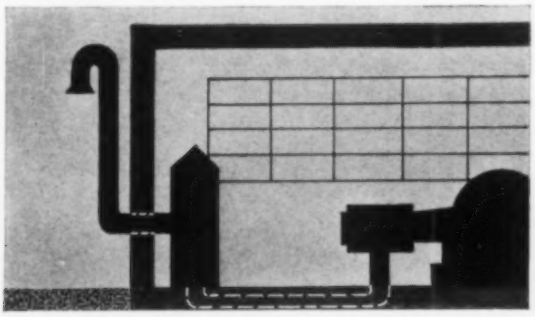


EXCLUSIVE RADIAL FIN CONSTRUCTION PROVIDES:

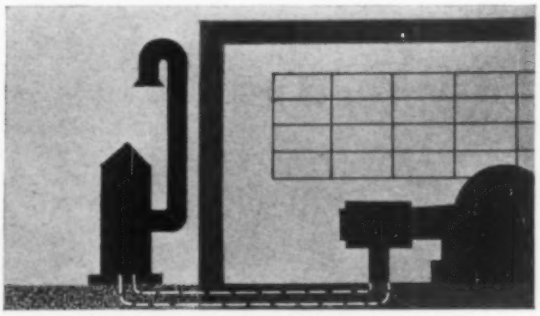
- ★More Filtering Area
- ★Greater Efficiency
- ★Less Resistance
- ★Less Frequent Servicing

The new filter, Staynew Model IDR, or IDRS (Silencer), is so constructed that *installation and servicing can be effected at ground level* (right in the engine room itself if preferred), and the *actual air intake located at the most suitable point.*

Models available with solid base for installation when compressor or engine intake is below floor level.



Model IDR INSIDE Engine Room



Model IDR OUTSIDE Engine Room

Engineering Data on request — STAYNEW PROTECTOMOTOR FILTERS — Representatives in Principal Cities

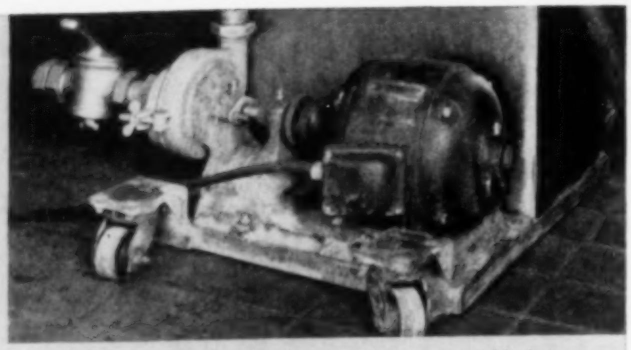
DOLLINGER CORPORATION

(Formerly Staynew Filter Corporation)

7 Centre Pk.

Rochester 4, N. Y.

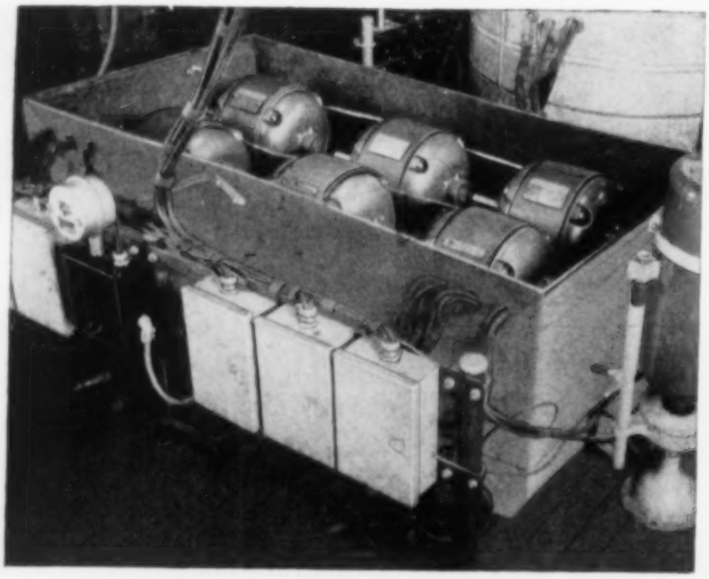
DOUSED DAILY!



G-E Tri-Clad motor coupled to a centrifugal pump on a portable cleaner in the milk plant of H. P. Hood & Sons, Inc., Charlestown, Mass.

POWERING A DAIRY PUMP, this Tri-Clad splashproof motor gets a dousing every day as the plant is hosed down. After years of service, frame and end shields are virtually uncorroded, insulation is going strong. G-E "protection tests", both in the development of the Tri-Clad design and in our daily production, help us assure you of long-lasting service from Tri-Clads on motor-wracking jobs like this.

"Hot Box" at 100% humidity tests TRI/CLAD motor protection



Here is one of the many development tests which helped to prove the *extra* stamina engineered into the Tri-Clad design. In the bottom of this moisture box, just below the motor base, two inches of water was maintained at 212 F. The cover kept the humidity within the box at 100 per cent. By operating motors in this atmosphere to the breakdown point, G. E. got the low-down on the coil insulation's moisture resistance. Tri-Clad motors, in both open and splashproof construction, showed up unusually well in this extra-severe test. *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

TRI/CLAD MOTORS

Every week more than 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

Sisters UNDER THE SKIN

PT BOATS and torpedo planes . . . both aim their tin fish by aiming themselves. Once launched, the torpedo speeds on its way propelled by compressed air.

Compressing wartime requirements of air for torpedoes, rock drills and other air tools in mines and factories, etc., requires maximum efficiency from compressors.

Using *Texaco Alcaid, Algol* or *Ursa Oils* assures wide-opening, tight-closing valves, free piston rings, open ports, clean air lines. This means maximum service life between overhauls, fewer repairs and replacements.

So effective have Texaco lubricants proved that they are definitely preferred in many fields, a few of which are listed on the right.

Texaco Lubrication Engineering Service is available to you through more than 2300 Texaco distributing points in the 48 States.

☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★ *More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.*

★ *More revenue airline miles in the U. S. are flown with Texaco than with any other brand.*

★ *More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.*

★ *More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.*

★ *More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.*

TEXACO
REG. T.M.

TEXACO Lubricants

FOR ALL AIR COMPRESSORS AND TOOLS

TUNE IN FRED ALLEN EVERY SUNDAY NIGHT—CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

Vogt
Vogt
FOR BETTER
VALVES AND
FITTINGS

PRODUCTS ARE

★ DESIGNED to RAISE
★ OPERATING STANDARDS and
★ LOWER YOUR COSTS

Drop Forged for Safety and Economy under the Most Trying Conditions

Valves, Fittings and Flanges by Vogt—the choice of operating men everywhere for safe and sure regulation of the high pressure and high temperature liquids and gases used in modern process work.

Vogt
FOR BETTER
BOILERS

High Operating Efficiencies and Low Maintenance Costs

More steam per dollar of investment—because Vogt steam generating equipment is designed and built to fit in with specific operating conditions. Vogt boilers are available in bent tube types and straight tube, forged steel sectional header types for solid, liquid, or gaseous fuels, as desired. Three-drum types can be supplied to fit any conditions of restricted installation space.

Vogt
FOR BETTER
REFINERY
EQUIPMENT

Meeting the Demands for Operating Security

Vogt has every facility for the fabrication of stills, towers, continuous rotary filters, filter presses, oil chilling machines, heat exchangers, etc., and these products are serving the petroleum industry around the world.

Vogt

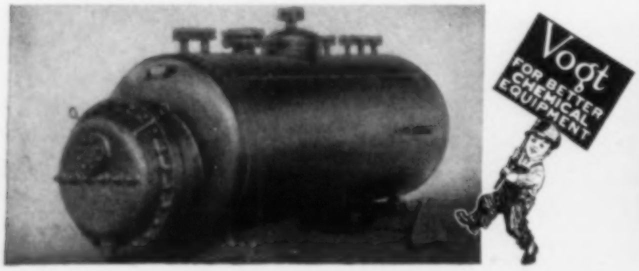
PRODUCTS

For Oil Refineries, Chemical Plants,
Power Plants and Related Industries

☆

HENRY VOGT MACHINE CO.

LOUISVILLE, KENTUCKY
NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS



Vogt
FOR BETTER
REFRIGERATION

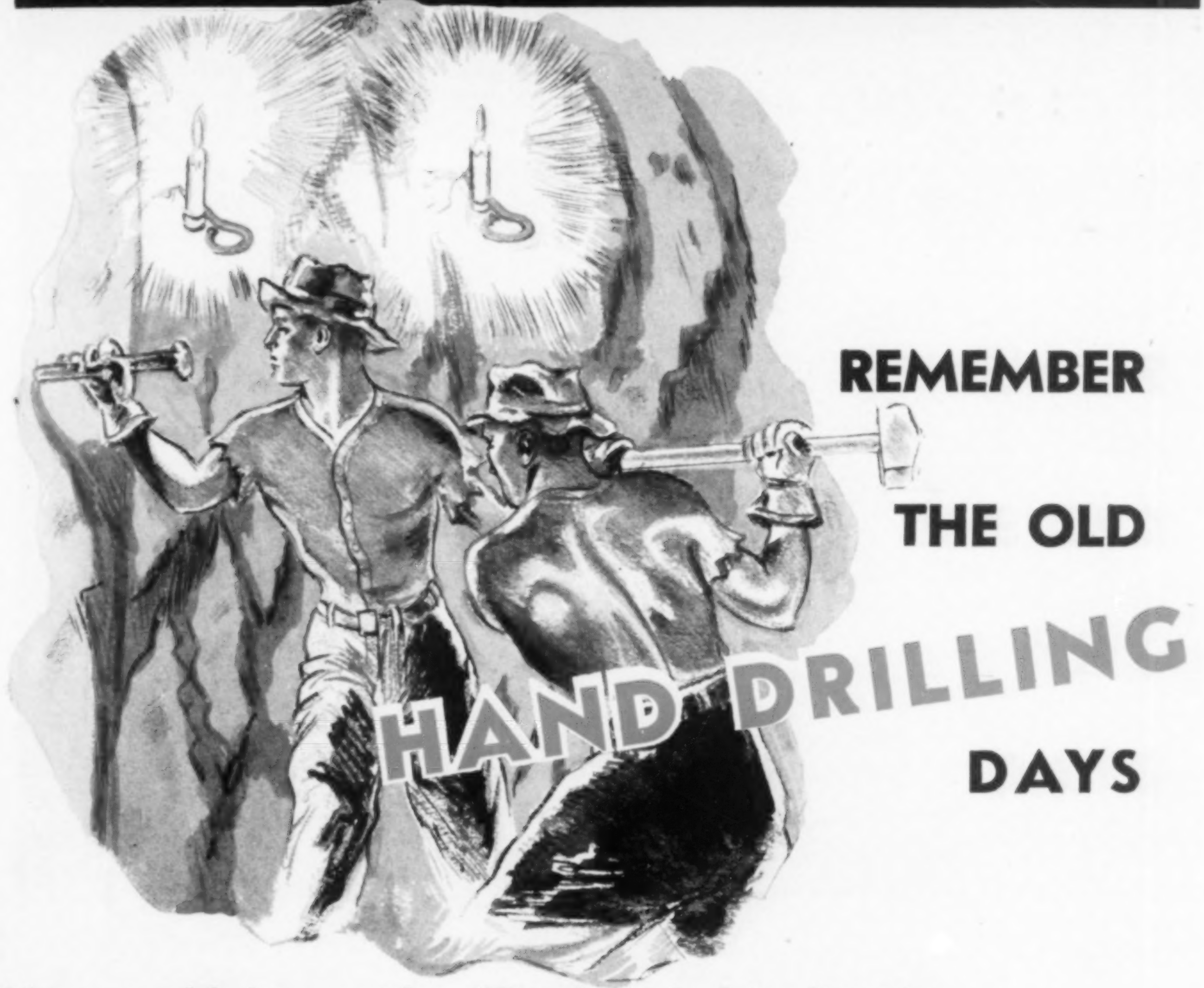
To Combat Corrosion and Product Contamination

Process equipment made from special metals and alloys for the exacting service of the chemical plant is fabricated in our modern shops for many of the well known chemical companies.

Steps Tonnage Up and Costs Down

Our experience of more than 50 years in building profit-making ice and refrigerating machinery is at your command. We make complete units for ice and cold storage plants, packing plants, dairies, breweries, chemical plants, oil refineries, etc.

HAND MUCKING IS AS OBSOLETE AS HAND DRILLING



You wouldn't consider "Double-Jacking" today

And no mining man who has ever used an Eimco Loader would go back to hand mucking.

The rocker-arm of an Eimco loader simulates hand shoveling action on a large scale. Now the hand mucker has become a loader operator and has at his disposal a simple, fast, powerful and easily operated tool. The Model 21 (Illustrated) with a 9 cu. ft. bucket loads cars up to 120 cu. ft. at the rate of 2 tons per minute.

Eimco alone, offers a complete line of loaders, each model with a full range of track gauges and discharge heights.

Write for informaton on Eimco loaders, and remember—hand mucking is as obsolete as hand drilling.

EIMCO

THE EIMCO CORPORATION SALT LAKE CITY 8, UTAH
NEW YORK, 120 BROADWAY
CHICAGO, 111 W. WASHINGTON ST.
SACRAMENTO, 1217 7TH ST
EL PASO, MILLS BUILDING

CAN YOU FIND THE TEN MINERS?

THERE'S actually only one miner in this picture of course. But he has nine mighty important helpers in the detachable bits—eight on the rack and one at the business end of his drill!

Detachable bits reduce steel shop costs and nipping charges. They permit more time for drilling because you don't have to carry steel in and out of working spaces. They drill faster than ordinary steel bits—even in soft or muddy ground.

All that's needed to keep them in condition is a simple forming and gauging operation with the right grinding wheel as in this picture. No forging or retempering is needed. And remember—grinding wheels are "Weapons for Production". Please use them wisely.

Every hour this war is shortened will save $12,000,000. The lives it will save are priceless. Let's get it over with—quickly.

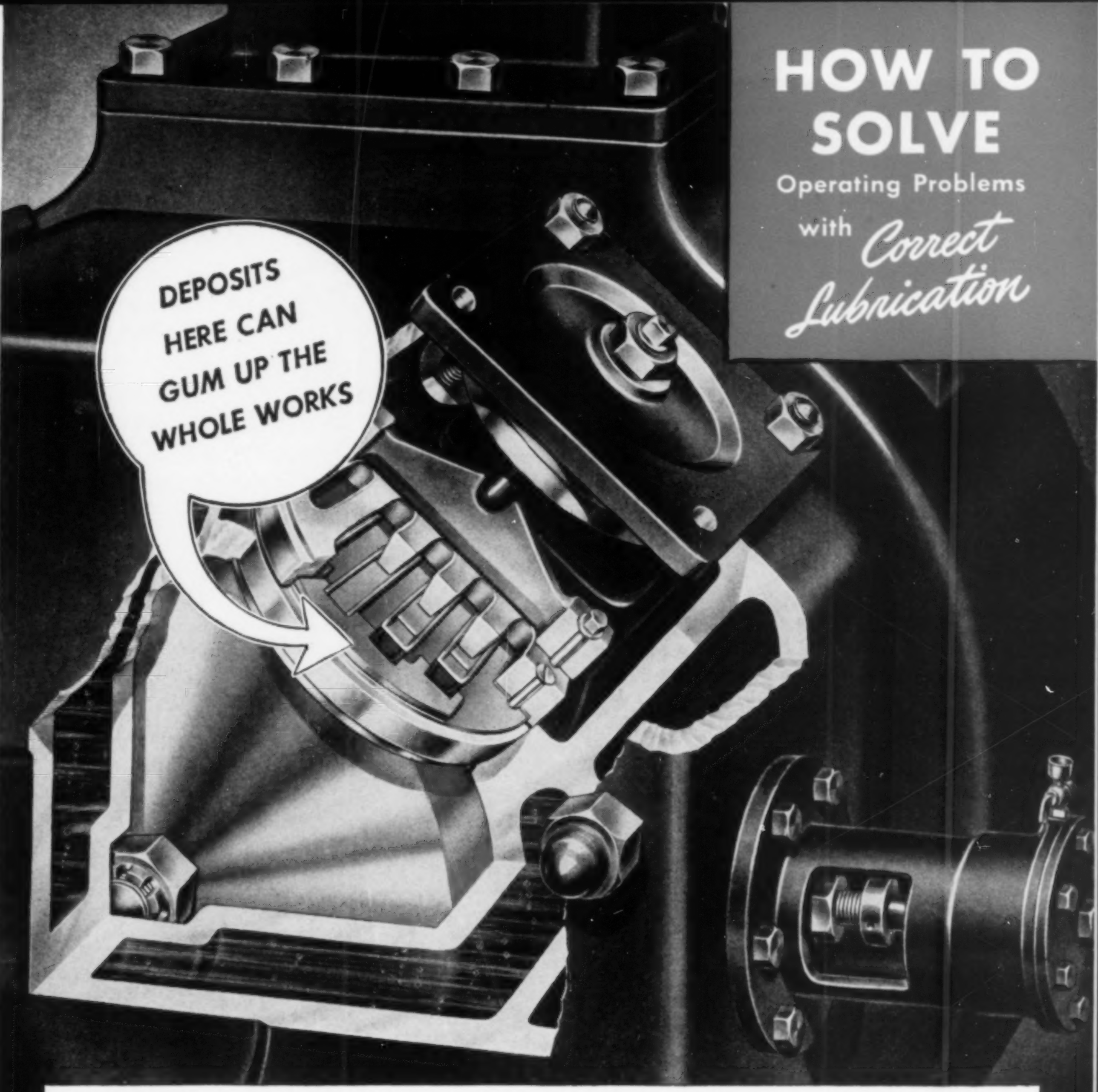
CARBORUNDUM
REG. U.S. BRAND PAT. OFF.
ABRASIVE PRODUCTS

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.
REG. U. S. PAT. OFF.

Sales Offices and Warehouses in New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh, Cincinnati, Grand Rapids
(Carborundum is a registered trade-mark of and indicates manufacture by The Carborundum Company)

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

HOW TO SOLVE
Operating Problems
with *Correct Lubrication*


DEPOSITS HERE CAN GUM UP THE WHOLE WORKS

Keep these valves clean!

THIS IS A "HOT SPOT"—and a danger spot—in air compressor operation. If oil oxidizes and forms carbon deposits here—in the valves—it can cause high discharge temperatures with dangerous consequences.

To prevent this, you need oils that have high chemical stability to resist oxidation. These oils must also have maximum lubricating value to lubricate pistons and cylinders efficiently.

Gargoyle D. T. E. oils for compressors have the combined characteristics for this job. Their strong film protects pistons, cylinders, and valves from wear with minimum oil feeds—and these oils fight the formation of deposits to keep the valves clean.

Be sure you have these oils in your compressor for maximum efficiency with the lowest possible maintenance and lubrication costs.

SOCONY-VACUUM OIL CO., INC.,
Standard Oil of N. Y. Div. • White Star Div. • Lubrite Div. • Chicago Div. • White Eagle Div. • Wadhams Div. • Magnolia Petroleum Company • General Petroleum Corporation of California.

GARGOYLE
Lubricants

CALL IN SOCONY-VACUUM

7½ TONS
OF METAL A SECOND

It takes "some drilling" to keep the boys in khaki supplied with metal. In ammunition alone, a modern armored division can fire up to 15,000 pounds of metal a second . . . to say nothing of the metals required to build tanks, trucks, ships, planes and guns.

And the mining men throughout the Americas have been drilling . . . for despite all handicaps, output in 1943 was greater than ever before.

The record-breaking performances of Ingersoll-Rand rock drills and Jackbits, the result of drilling speed, efficiency and reliability, are helping the United Nations to make 1944 the greatest ore production year ever. Ask the nearest engineering service division to help you select the drill and Jackbit best suited to your particular drilling conditions.

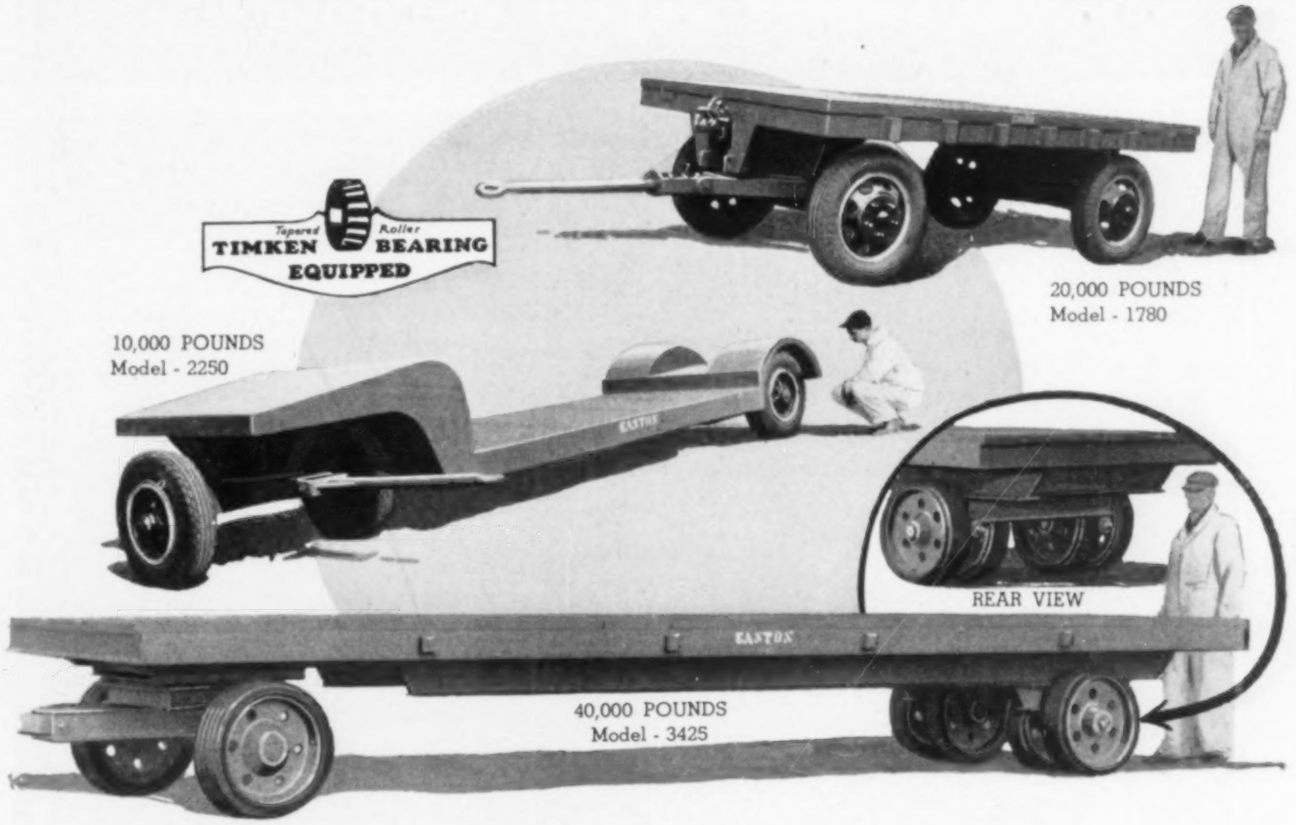
ARMY E NAVY

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

5-365

COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES • CONDENSERS • CENTRIFUGAL PUMPS

EASTON
. . INDUSTRIAL TRAILERS



20,000 POUNDS
Model - 1780

10,000 POUNDS
Model - 2250

40,000 POUNDS
Model - 3425

for extra heavy-duty *Service*

The transportation of heavy materials within the plant often presents a real problem to war industries. By developing heavy-duty, rubber-tired trailers for the really tough jobs, EASTON has made a major contribution to the war effort. EASTON makes a specialty of engineering these high-capacity industrial trailers for the systematic handling of heavy materials that just can't be transported by conventional methods.

EASTON makes no attempt to build all types of trailers. Instead, time and attention are given solely to those projects where extra-heavy duty is involved. Shipyards, steel mills, shell plants, and other war industries use EASTON trailers to keep heavy materials on the move.

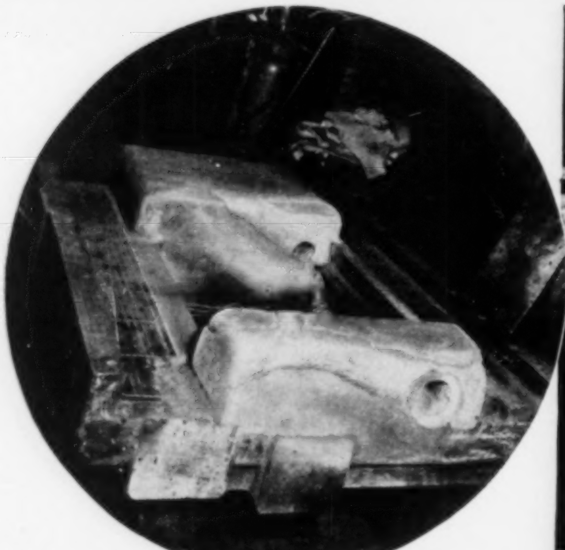
Many of these husky trailers have been in use since the early months of the war. They will still be going strong many months from now!

The limit in size or capacity of industrial trailers has not yet been reached . . . but EASTON is keeping step with this trend. Let EASTON figure on your requirements.

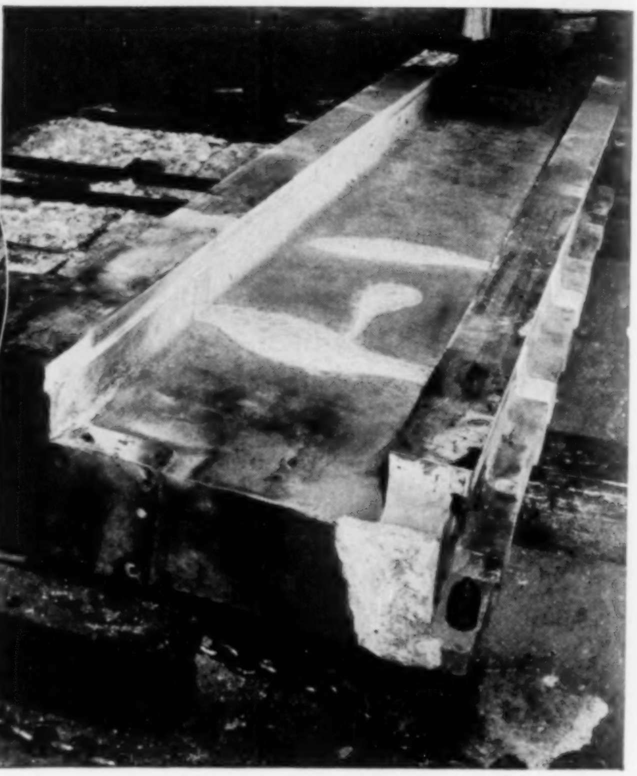
A-1004

EASTON CAR & CONSTRUCTION COMPANY · EASTON, PA

Chalk up *ANOTHER PRODUCTION VICTORY* for Bronze Repair Welding



Above: 3,000-pound saddle of milling machine reclaimed by Bronze Welding.



Right: Severed ribs in this base were welded as well as part of the bed.

A MILLING MACHINE was being moved to an important new war production job when the chain supporting it broke. Crashing to the floor, the machine was badly damaged. A long, costly production delay threatened until a new one could be obtained.

Then bronze welding came into the picture. Using this time-proved repair process, both the 15-ft. long base, weighing approximately 19,000 pounds, and the 3,000-pound saddle were quickly repaired by the Super Arc Welding Company, Detroit, Mich. 850 pounds of 3/8" Tobin Bronze* Welding Rod put the machine back on the job in a week.

For speedy repair welding of cast iron, steel, malleable iron and copper, don't overlook the advantages of such rods as Tobin Bronze and Anaconda 997 Low Fuming. Complete information on these and other Anaconda Welding Rods is contained in Publication B-13. Copy on request.

4377

FOR VICTORY—BUY MORE WAR BONDS

*Reg. U. S. Pat. Off.

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY—General Offices: Waterbury 88, Conn.
Subsidiary of Anaconda Copper Mining Company—In Canada: Anaconda American Brass Ltd., *New Toronto, Ont.*

Piping Pointers
FOR INDUSTRIAL MAINTENANCE MEN
New 16-mm.
Sound Film
Full of Valuable
"KNOW HOWS"
For Trainees and Veterans

Now being shown FREE in any plant

SEEING this film gives maintenance trainees a quicker grasp of their jobs—a better understanding of various types of valves and fittings—how they are used and installed to insure long life and good performance. In addition, *"Piping Pointers"* explains correct maintenance procedures—shows how to conserve time and materials on the job.

Because *"Piping Pointers"* is packed full of authentic and practical information—because its ultimate benefit is better service from piping equipment—numerous plants are showing it to both trainees and veteran workers.

New Training Manual Included

Making *"Piping Pointers"* even more effective, is a new comprehensive training manual which covers in greater detail each subject treated in the film. It can be used with the film or separately.

Both the film and manual are the first of their kind ever compiled. But more important is that each lesson they give can be fully depended on as the best information available. For their content is based entirely on Crane Co.'s 88-year experience as the leading maker of valves and fittings.

Act Now to Show This Film to Your Men—More and more requests for *"Piping Pointers"* are coming in daily. Assure a convenient early showing in your plant by getting in touch with your local Crane Branch promptly. Use of the film will be arranged and manuals provided for every viewer. Just call your Crane Branch, or, if you prefer, fill in and mail the coupon below.

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Illinois.

FILL IN AND MAIL TODAY

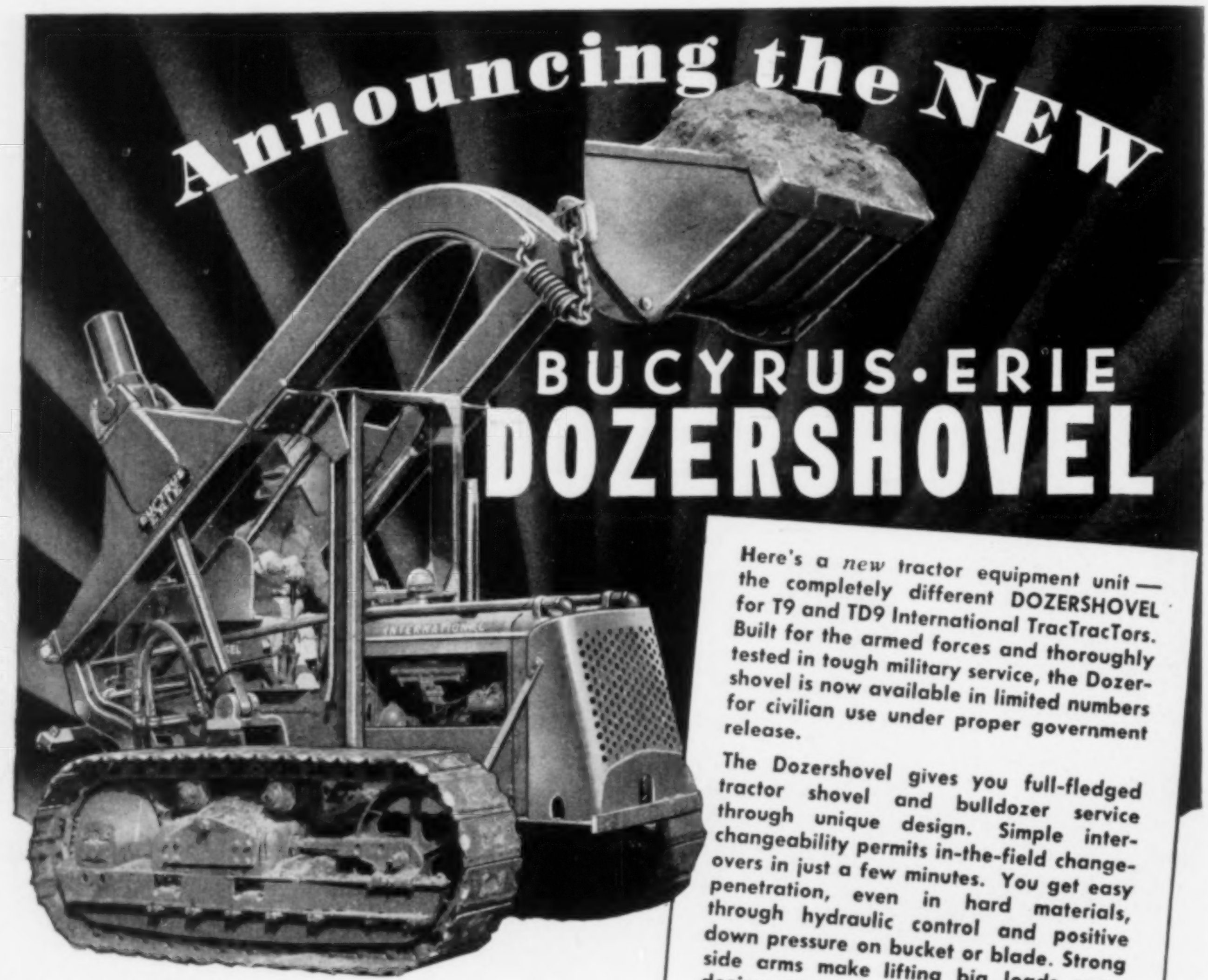
CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Attention: Advertising Dept.

Put us down for the earliest possible showing of *"Piping Pointers."* Have the local Crane Branch get in touch with me.

Name..
Title..
Company..
Address..
City.............................*State*..............

CRANE VALVES

Announcing the NEW



BUCYRUS·ERIE DOZERSHOVEL

Here's a *new* tractor equipment unit — the completely different DOZERSHOVEL for T9 and TD9 International TracTracTors. Built for the armed forces and thoroughly tested in tough military service, the Dozershovel is now available in limited numbers for civilian use under proper government release.

The Dozershovel gives you full-fledged tractor shovel and bulldozer service through unique design. Simple interchangeability permits in-the-field changeovers in just a few minutes. You get easy penetration, even in hard materials, through hydraulic control and positive down pressure on bucket or blade. Strong side arms make lifting big loads easy, dozing sure and smooth. Other features are unobstructed visibility, oscillating tracks, and low overhead clearance. Lifting crane service is made possible by a hook on the upper edge of the bucket or blade.

Get the detailed story on this economical dirt mover from your International TracTracTor distributor. The Dozershovel is a new gateway to greater profits.

- **POWERFUL DIGGING AND DOZING**

Not just another front-end shovel, the Dozershovel is **both** shovel and dozer. It easily digs and lifts heaping buckets, dozes full blades and level cuts. Hydraulic control and down pressure up to 4200 pounds give real "bites," even in tough materials.

- **UNOBSTRUCTED VISIBILITY**

No blind spots, no "guessing the load" with the Dozershovel. Its full visibility permits the operator to load full buckets quickly, to dump accurately, to doze a level surface. This feature is important in reducing operator fatigue, too.

- **INTERCHANGEABILITY**

It takes only a few minutes to change over in the field from shovel to dozer. Just remove five pins holding the bucket, trip latch, and limit chains; set blade in place; replace pins, and the job is done. The bucket trip mechanism is a big help in dozing, too, for it permits tipping the blade forward to free the blade of its load on uphill work.

BUCYRUS ERIE
TRACTOR EQUIPMENT

SEE YOUR
INTERNATIONAL TRACTRACTOR
DISTRIBUTOR

These
Ex-Skilled Workers
would be
On the Job Today
IF THEY HAD WORN
AO
GOGGLES

. . . Are you protecting Your Skilled Workers' EYES?

Many tool makers . . . die makers . . . master mechanics . . . expert lathe operators and other much-needed skilled workers could be helping the war effort and their former employers right now *if* it hadn't been for eye accidents—which could have easily been avoided.

There is an indisputable moral in this condition for those companies that have not yet lost key workers, even though failing to provide them with goggles: *don't continue to take chances with the law of averages —install an employee-protecting, money-saving goggle program* NOW!

American Optical Company offers you an entire line of comfortable goggles, each scientifically designed to meet specific types of eye hazards. Get in touch with your nearest AO Branch Office . . . or have an AO Safety Representative call.

American Optical
COMPANY
SOUTHBRIDGE, MASSACHUSETTS

A PICTURE OF SKF PERFORMANCE

● *Motorpumps built by* INGERSOLL-RAND CO.

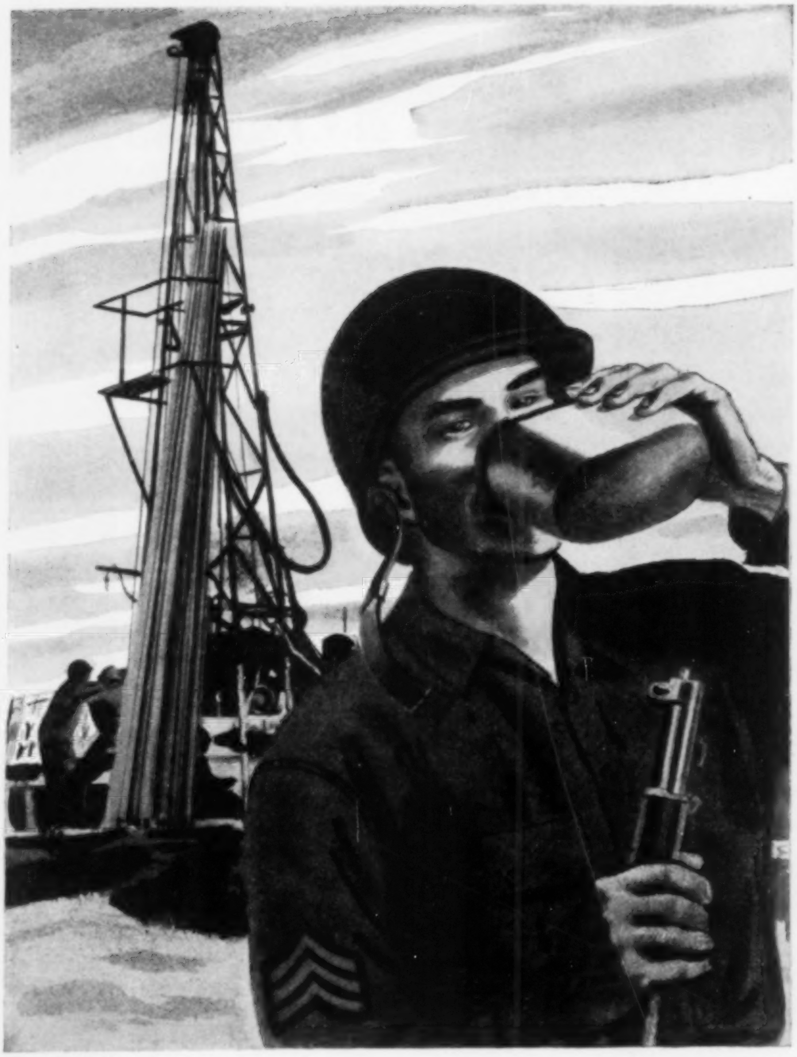
Removing Water
EASILY

How many gallons of water this Motorpump removes from a Utah lead mine is contingent upon how long it runs smoothly. That it is SKF-equipped is assurance that it will operate without bearing trouble at its rated capacity of 500 gallons per minute against 220 ft. head. Radial and thrust load carriers, SKF's help moving parts function easily—help with every revolution to remove water from the mine workings and thus step up the output of a vital raw material. Another example of SKF's in action.

5464

SKF INDUSTRIES, INC., PHILA. 34, PA.

SKF
BALL AND ROLLER
BEARINGS



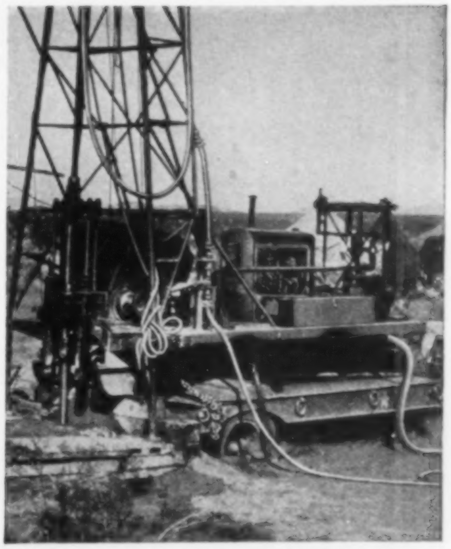
"But You've Got To Drill For It!"

Thirsty work—plowing across blazing desert—slogging through murky jungle—crouching in the rubble of blasted towns.

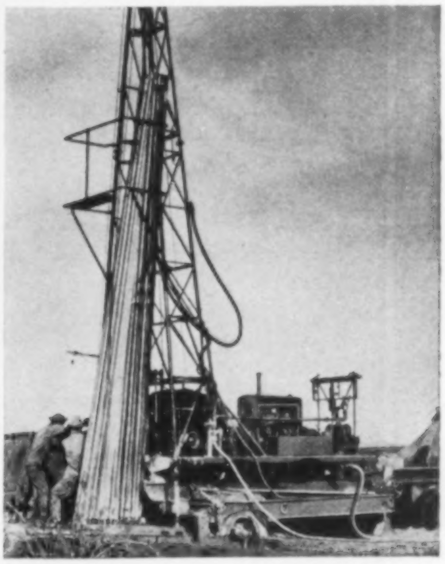
Wherever they are, our soldiers get plenty of fresh water to drink. When it isn't in sight or when what's in sight may not be safe—you've got to drill for it, deep underground.

With the Army on the move, maintaining an ample water supply, sometimes under fire, means drilling fast, whipping away to another sector, drilling again. A tough problem in equipment, that! But it's been licked—rubber helped.

The George E. Failing Supply Company of Enid, Oklahoma, in conjunction with the U. S. Army Corps of Engineers, designed the needed high-speed, portable drilling rig. Working with them, United States Rubber Company provided various types of special hose—rugged enough for this rough, tough service but extra lightweight to keep pounds at a minimum.



THE HIGH-SPEED, PORTABLE DRILLING RIG is moved right up to the front lines by combat troops. The extremely flexible United States Rubber Company hose with which it is equipped is not only very strong but so much lighter weight than commercial hose made for similar purposes that there is a saving of several hundred pounds to be transported.



THE FIVE DISTINCT TYPES of United States Rubber Company hose supplied for the combat-zone drill rig are: high-pressure rotary hose; mud-suction hose, capable of being re-shaped if crushed; light, strong, wash-down water hose; high-pressure hose for hydraulic controls; oil suction hose for hydraulic system. These hose, as well as the special rubber valves, pistons and packings also supplied by the United States Rubber Company, are all specially designed to get water fast and to be tough for front line service.

United States Rubber Company engineers have aided many manufacturers in their problems of supplying articles of rubber for direct warfare use by the Armed Forces . . . as well as rubber equipment for plant production, safety and protection uses.

1230 Sixth Avenue • Rockefeller Center • New York 20, N. Y.

UNITED STATES RUBBER COMPANY

Fast Cutting
NORTON RESINOID DISCS

Can Speed Many Surfacing Jobs

IF you are using disc grinders for finishing castings or other surfacing jobs you'll want to take advantage of the fast cutting action of Norton Resinoid Discs.

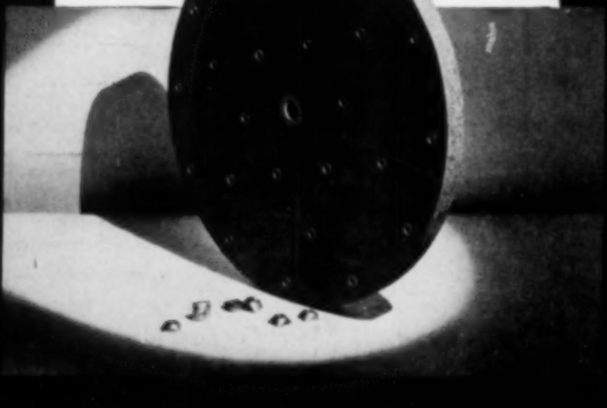
Countless resinoid bond formulae were studied by the Norton research laboratories to develop one with just the right strength for foundry service—a bond that would hold each grain firmly until its job was done, then release it to bring fresh, sharp grains into action.

Norton Resinoid Discs are available in Alundum abrasive for steel castings and in Crystolon abrasive for gray iron castings. They are made in sizes and mountings for all types of disc grinders—vertical or horizontal spindle. Norton abrasive engineers are ready to study your disc grinding jobs and specify the correct Norton Disc for each.

And there's a special Norton booklet on discs. Just write for Form 1141-CA.

NORTON COMPANY
WORCESTER 6, MASS.

W-951



NORTON ABRASIVES

ON THE COVER

OUR cover picture shows one of the three blast furnaces at the new plant of the Geneva Steel Company which is now getting into production.

•

IN THIS ISSUE

IF YOU were asked to name the Pacific Coast's largest use of steel during normal times, what would you say? The correct answer is tin plate, for the coast puts up vast quantities of fruits, vegetables, and fish. This being true, it is significant that the new steel mills in Utah and California can readily be converted to produce tin plate when peace comes. Right now they are turning out ship plates to help win the war. Our leading article gives the highlights of the vast new government-owned plant at Geneva, Utah, which the United States Steel Corporation has built and is operating.

•

POWER shortages are nothing new to Tacoma, Wash., which has long operated its own hydroelectric facilities. A few years ago a United States battleship supplied the city with current to tide it over during a period of low stream flow. Now Tacoma is moving toward electric self-sufficiency by developing additional power plants on the Nisqually River, as described by Henry W. Young.

•

SINCE compressed air is indispensable in the building of military aircraft, compressor plants for plane factories are chosen and set up with great care. W. M. Gebo gives us a detailed description of the air-supply facilities at a Douglas factory. Of chief interest is the fact that three gas-engine-driven machines can produce either air or electricity, as occasion requires.

•

"MY DAY" takes us partway around the clock with an engineer-author who set out to see how many times he and compressed air crossed paths during a normal business day. When he tallied up, he was surprised, and so were we. You may be, too.

•

CORRECTION

IN THE article, *Treasury Tunnel to Reopen Old Mines*, in our January issue, it was stated on page fifteen that the estimated cost of the tunnel and raise is $189,000. This figure should have been $289,000.

Compressed Air Magazine

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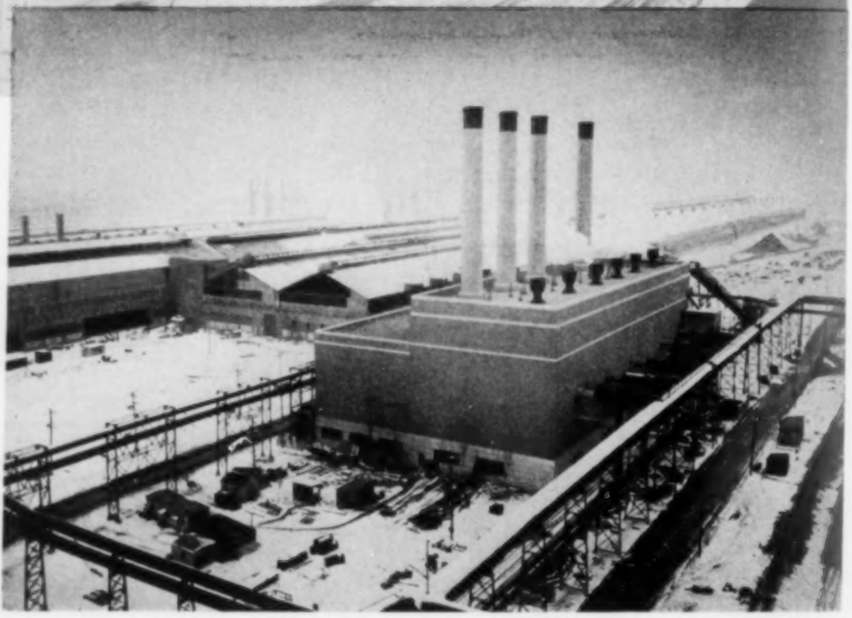
Utah Now Producing Steel

C. H. Vivian



GENERAL PLANT VIEWS

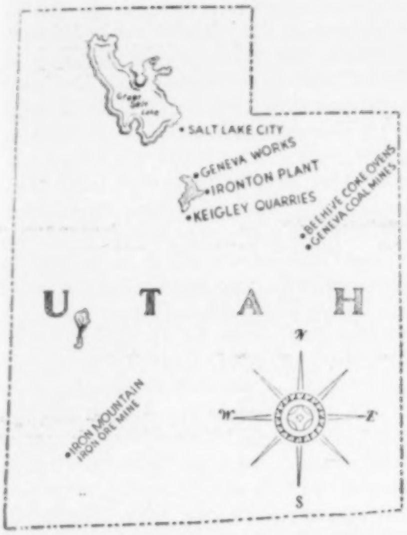
The Geneva establishment is so extensive that no single picture taken from the ground can clearly portray more than a small section of it. At the top is a general view looking across the railroad classification yard toward the zone of operations. The rolling mills are at the left, the blast furnaces and coke ovens in the center, and the coke-oven by-products plant is at the right. Immediately above is the powerhouse, with the rolling-mill area in the background. On the opposite page is a close-up of the coke-oven-gas by-products zone with a 500,000-cubic-foot gas holder in the center (left), and a part of the works with 12,008-foot Mount Timpanogos as a backdrop (right). The map shows the location of the plant and of the mines that supply it with raw materials.

AT GENEVA, in Utah, 40 miles south of Salt Lake City and 6 miles from Provo, a $180,000,000 steel plant is nearing completion. It is being built with Federal funds and will be operated for the Government during the war-emergency period by the Geneva Steel Company, a subsidiary of the United States Steel Corporation. When the war is over, it will be sold either to Geneva or to some other operator, the contract now in force providing merely that Geneva shall have the nonexclusive right to purchase the property within 90 days from a date to be set by the Government.

In physical proportions and capacity of output, the Geneva plant is a large one, comparing favorably in those respects with like units of established steel-producing concerns in other parts of the country. In modernity, it represents the last word, for it incorporates the best equipment and the most efficient practices thus far developed in the industry. In the words of one of Geneva's operating engineers, the plant represents the fulfillment of a steel man's dreams. "In building it," he said, "it has been possible to put in every desired modern feature exactly as it should be. This is in contrast to the usual procedure, where additions to existing plants must be made to fit the available space and where there are generally other limiting factors that necessitate a compromise of some sort. Because we have been able to build this plant exactly as we wanted to, from the ground up, it should have high inherent operating efficiency."

In making the Geneva works thoroughly up to the minute, its designers and builders have, however, included nothing that has not been successfully used before. On this point President Walther Mathesius of Geneva Steel Company says: "Everything in the plant has been proved elsewhere; there are no experiments." Mr. Mathesius also gives assurance that the huge industrial establishment that has taken root in a scenic section devoted preponderantly to agriculture will not, as some Utahans have feared, turn out to be an undesirable interloper. "It will not mar the landscape," he promises, "nor will it cast a pall of smoke over the valley. There is nothing in the plant to make smoke except the steam locomotives, and these will be removed as soon as we can obtain diesel units to replace them."

The plant was created to provide an additional source of iron and steel close to the shipbuilding yards and other war industries on the Pacific Coast. In normal times the bulk of these products reaches the West Coast users by water transportation from eastern and southern mills; but the submarine menace, the inordinate demand upon shipping, and the possibility that the Panama Canal might be damaged by attack combined to shift most of the haulage to the railroads. It s generally conceded that these carriers have done a valiant



job in the face of continually rising requirements, but there is need for lightening their burden, and this will be accomplished when the Geneva mill goes into full production.

The plant was located in Utah because the essential raw materials for steelmaking—iron ore, coal, limestone, and dolomite—are all obtainable within the borders of the state. The Geneva site was selected because it affords adequate transportation and water-supply facilities and because that general section is sufficiently populated to provide a considerable percentage of the 5000-man operating force that will be needed. Main-line tracks of the Union Pacific and The Denver & Rio Grande Western railroads border the site, in fact, cross each other at one end of the property. In terms of freight rates, the mill is approximately equidistant from Los Angeles, San Francisco, and the Seattle-Portland industrial districts.

Prior to the war, the nearest integrated steel mill to the Pacific Coast was the Colorado Fuel & Iron Company plant at Pueblo, Colo., which is roughly 1400 miles from each of the three major far-western manufacturing areas just mentioned. The Colorado mill makes a considerable range of products, but does not turn out large quantities of the items that are required to meet the wartime demands of the Pacific Coast. Aside from the Pueblo works, the Columbia Steel Company, a United States Steel subsidiary, is making pig iron at its Ironton plant near Provo, which has been in operation since 1924. This is being shipped to Columbia's steel plants at Pittsburg and Torrance, Calif. The original Columbia furnace is of 685 tons daily capacity. To augment its wartime output, the company was directed by the Defense Plant Corporation to move an idle furnace of 900 tons daily capacity from Joliet, Ill., and to set it up at Ironton. This went into production on July 6, 1943. Bethlehem Steel Company also has some small mills on the coast, and other steelmaking plants there are conducted by Judson Steel Corporation, Pacific States Steel Corporation, Pacific Tube Company, and Southwest Steel Rolling Mills. All these, however, have been obliged to use pig iron produced elsewhere in the country. Now, as a result of the wartime demand for steel occasioned by the phenomenal industrialization of the Pacific Coast, that sector of the nation is being provided with the Geneva mill and with the plant of Kaiser Company, Inc., at Fontana, Calif.

When the Government set about to build a western steelworks, the Office of Production Management requested the United States Steel Corporation to submit a plan. This was completed on May 8, 1941, and was considered in conjunction with others before the Geneva location was decided upon. With this and other preliminaries disposed of, the Defense Plant Corporation, a subsidiary of the Reconstruction Finance Corporation, awarded a general contract for the construction of the works to the Columbia Steel Company. The latter concern called upon the experience, resources, and personnel of other United States Steel units to oversee the huge building job and to supervise the task of selecting, ordering, and erecting the necessary equipment and machinery. The contract provided that all this should be done without profit to United States Steel, which is also to operate the mill on the same basis.

Actual construction of the Geneva

IF BRIGHAM YOUNG, who led the Mormons westward nearly a century ago, could return today to Salt Lake Valley, he would see one of his cherished hopes realized. He tried, without success, to establish an iron industry in Utah that would make his people independent of outside sources. In 1849, only two years after the Mormons set foot in the valley, Young sent out an exploring party that discovered iron deposits near those that now supply the Geneva Steel Company. Colonists, some of whom had been ironworkers in England, settled there and built a blast furnace that was tapped on September 30, 1852, to yield the first pig iron made west of the Missouri River. The Deseret Iron Company was formed and financed to the extent of $16,000 by selling stock to Mormon converts in England. The operations were unprofitable and, for a time, received assistance from the Territory of Utah at the behest of Young, its first governor. But in 1858 the works closed down and were never reopened.

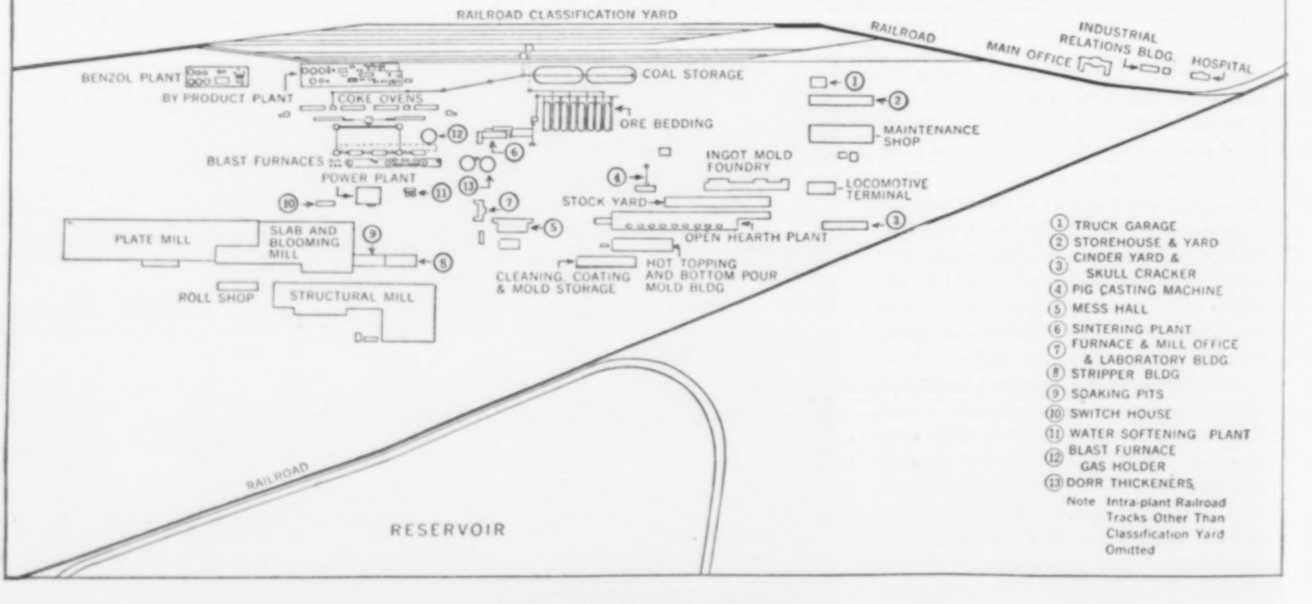
The Great Western Iron Manufacturing Company set up a blast furnace and auxiliary structures near Iron Mountain in 1868 and produced stoves, pots, buckets, and other castings until 1883, when this venture also failed. No more iron was made in Utah until Columbia Steel Company blew in a blast furnace at Ironton in 1924. Its success in using coke made from Utah coal undoubtedly had a bearing on the Government's decision to build the Geneva steelworks.

plant was broken down into more than 100 subcontracts, all coördinated and directed by the Defense Plant Division of the Columbia Steel Company. E. M. Barber, who had previously been vice-president and general manager of the Boyle Manufacturing Company, was placed in charge with the title of vice-president. He had a force of two men when he started work on November 1, 1941. A month later he opened an office in Chicago and began gathering around him keymen from the United States Steel organization. Among them were four engineers from the Carnegie-Illinois Steel Corporation: A. J. Hulse and James K. Lamoree, who were named chief engineer and assistant chief engineer, respectively; George Bauer, who became design engineer; and John Brown, who was made chief civil engineer.

Around this nucleus was built an engineering staff, and within four months enough of the design details were on paper to permit awarding some of the contracts and to break ground at the site. Thirty days later 1200 men were at work, and within another month there were 4000. Eventually 10,000 were employed at Geneva, in addition to those required to open up deposits of ore, coal, and stone, and 4000 more men could have been used if they had been available. Another Carnegie-Illinois man, R. C. Talbott, was appointed construction engineer; and M. B. Sheik, who came to the job with one of the contractors, was made project manager to direct and to coördinate all the construction activities. Mr. Sheik brought with him experience gained at Boulder and Grand Coulee dams, the San Francisco Bay Bridge, and other large projects. Various engineering firms that specialize in designing component parts of steel mills also were commissioned to plan and supervise the building of various essential features of the plant.

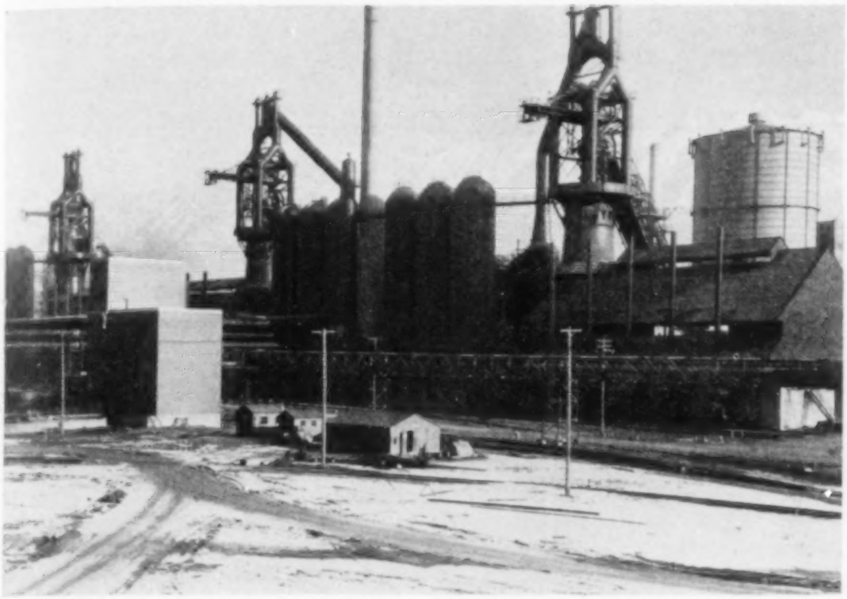
The Geneva works occupies a 1600-acre site in a broad, gently sloping valley that has been devoted to farming since the Mormon people first settled there in 1847. On the east is the Wasatch mountain range, dominated in that particular section by Mount Timpanogos, which rises to an elevation of more than 12,000 feet. On the other side of the valley are the Oquirrh Mountains. The plant is located on the north shore of Utah Lake, which is 20 miles long and contains fresh water, in contrast to the high salinity of Great Salt Lake some 35 miles northward. The structures stretch out for 2½ miles, one of the rolling-mill buildings alone having a length of 3750 feet. Bordering the plant on the east is the concrete highway running between Salt Lake City and Provo. Most of the employees will get to their work in cars, and a mile-long parking field has been provided for them.

Grading and excavating, handled by Utah-Pomeroy-Morrison of San Francisco, involved the moving of 2,800,000 cubic yards of earth. Because the undertaking carried a lower priority rating than numerous other government-sponsored war plants, noncritical materials


RAILROAD CLASSIFICATION YARD
RAILROAD
INDUSTRIAL RELATIONS BLDG.
MAIN OFFICE
HOSPITAL
BENZOL PLANT
BY PRODUCT PLANT
COKE OVENS
COAL STORAGE
ORE BEDDING
MAINTENANCE SHOP
BLAST FURNACES
POWER PLANT
INGOT MOLD FOUNDRY
LOCOMOTIVE TERMINAL
STOCK YARD
OPEN HEARTH PLANT
PLATE MILL
SLAB AND BLOOMING MILL
ROLL SHOP
STRUCTURAL MILL
CLEANING, COATING & MOLD STORAGE
HOT TOPPING AND BOTTOM POUR MOLD BLDG
RAILROAD
RESERVOIR
① TRUCK GARAGE
② STOREHOUSE & YARD
③ CINDER YARD & SKULL CRACKER
④ PIG CASTING MACHINE
⑤ MESS HALL
⑥ SINTERING PLANT
⑦ FURNACE & MILL OFFICE & LABORATORY BLDG
⑧ STRIPPER BLDG
⑨ SOAKING PITS
⑩ SWITCH HOUSE
⑪ WATER SOFTENING PLANT
⑫ BLAST FURNACE GAS HOLDER
⑬ DORR THICKENERS
Note Intra-plant Railroad Tracks Other Than Classification Yard Omitted

PLAN OF GENEVA WORKS

The structures occupy a triangular plot lying between two main-line railroads. Although the layout is such as to reduce cross hauling to a minimum, nearly 70 miles of intra-plant trackage is required. The 1600-acre site provides ample room for possible future expansion. At full capacity, the plant will employ some 5000 persons.



BLAST FURNACES

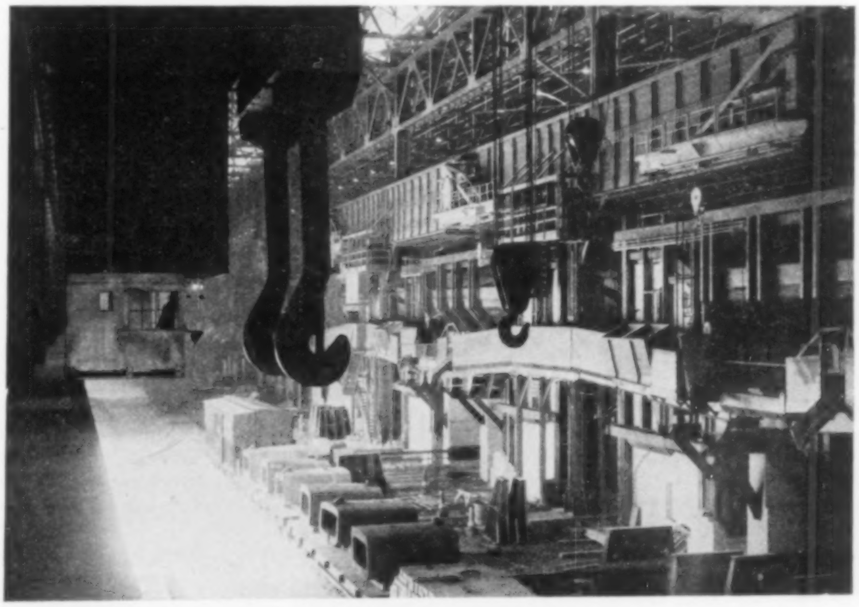
Each of these 100-foot-high stacks has a hearth diameter of 25 feet and a rated daily capacity of 1120 tons of iron. Iron ore, coke, and limestone are charged into the top of each furnace by a car that travels up and down the inclined skipway shown at the far side of the stack. The three vertical cylinders near each unit are the stoves in which blast air is heated prior to entering the bottom of the furnace. At the right is a 1,000,000-cubic-foot holder for blast-furnace gas. The blast furnaces were designed and constructed by the Freyn Engineering Company of Chicago, Ill.

were used wherever possible, resulting in some departures from standard practice in steel-mill construction. For example, only the powerhouse stacks are of steel, all others being of concrete, which was also utilized for the ore bins. All told, 500,000 cubic yards of concrete was poured. Nevertheless, structural steel ran to 85,000 tons, most of which was erected by the American Bridge Company, a United States Steel subsidiary. Steel sheeting for enclosing buildings aggregated 83 acres, this being the first job encountered by Project Manager Sheik where that item bulked so large that it was found convenient to express it in terms of land measurement.

Many of the construction workers came from considerable distances, and housing facilities in and near Provo were soon overtaxed. To relieve the situation, there were built at the plant site for single men twelve frame barracks with 1-room accommodations for 1050 and 2-room quarters for 590. To take care of families, two camps were established convenient to the work by the Federal Public Housing Authority and equipped with about 800 trailers. Each has two rooms, is wired for electricity, and has an oil stove and a water tank that is filled daily from taps throughout the camp. Toilet, shower-bath, and laundry facilities are centrally located in separate trailers. An air-conditioned cafeteria and canteen was erected at the plant and will remain as a permanent structure. It has several refrigerating systems for keeping foods at the most desirable temperatures, and its kitchen is rated as the most modern in the state. An average of 4500 meals is served daily, and the building contains a barbershop, a store, and billiard, card, and lounging rooms. Church services are held there every Sunday morning by different denominations, in turn. For housing the permanent population that the Geneva plant will support, the FHA is insuring about $10,000,000 of new construction loans in the Provo area for the erection of 2500 homes, most of which are of 5-room size.

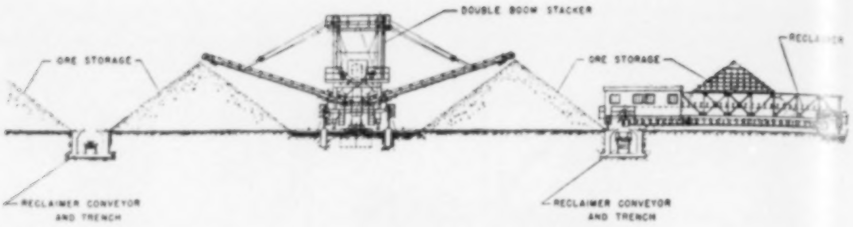
The Geneva works has three blast furnaces that have a rated daily capacity of 1120 net tons of iron each and a combined yearly output of around 1,150,000 net tons; nine 225-ton open-hearth furnaces that can produce 1,280,000 net tons of steel ingots annually; and rolling mills capable of turning out each year 900,000 net tons of finished products. The rolling mills include a 45-inch-wide slabbing mill, a 132-inch-wide continuous plate mill, and various supplementary structures. A 26-inch-wide mill for rolling annually 200,000 net tons of different structural shapes, billets, and rounds was added to the layout after the first plans were made and put under construction, but the recommendation covering it was withdrawn by the War Production Board last December. It may be completed, though it is not the intention to operate it at once.

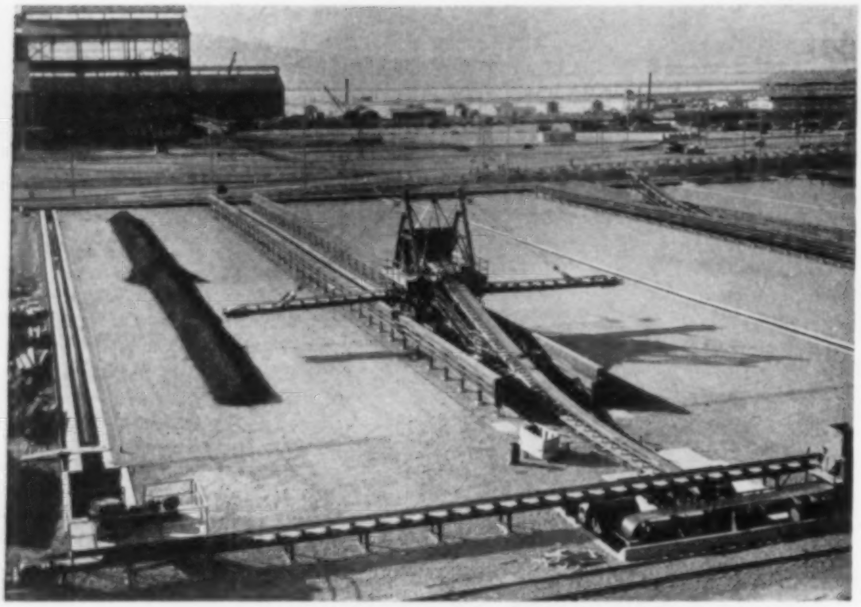
Complementing these major facilities are the numerous others that go to make up an integrated steelworks. These include coke ovens and their extensive associate equipment for the making of



OPEN-HEARTH FURNACES

Shown here is the charging-floor side of the nine 225-ton furnaces that produce the steel. The latter are fired with a mixture of tar and coke-oven gas. The heat in the spent gas from the combustion zones is utilized under waste-heat boilers to add to the plant's steam supply. As most of the steel is used for making ship plates, it is important that the ingot surfaces be good, and this is promoted by bottom-pouring and by careful maintenance of the ingot molds. For this purpose there has been provided a conditioning building where the molds are periodically cleaned and coated. Ingots poured in the open-hearth plant are transported to the slabbing mill where they are stripped from the molds and placed in soaking pits to bring them up to the prescribed temperature for rolling.





ORE-BEDDING SYSTEM

As there is some variation in the ore taken from different parts of the open-pit mine, mixing is necessary to obtain uniformity. This is done at the steel plant. As illustrated here, the ore is spread in successive horizontal layers by means of double-boom traveling stackers. The resultant long, narrow piles are then sliced down from top to bottom, taking some material from each layer. The drawing shows the stacking and reclaiming operations in cross section. When built up to full size, each pile will contain 13,600 tons. There is storage space for eight piles, or for a 10-day supply of ore for the blast furnaces.

by-products: a sintering plant for putting fine ore in a more usable form, soaking pits for reheating ingots before rolling them, a powerhouse with a generating capacity sufficient for a city of 100,000 persons, a water-supply system with unusual features, a maintenance shop outfitted to repair any piece of equipment in the plant, a shop for dressing mill rolls, a foundry for casting molds and other articles, a pig-casting machine, a locomotive terminal, a mess hall, laboratories, engineering and general offices, a hospital, and other structures. All are essential to the operations, but in an article of this length some of them will have to be passed over with mere mention. An accompanying map shows the general plant layout.

Raw materials enter the works by way of a multitracked railroad classification yard on the west side. From that point onward everything is laid out to facilitate their effective handling and to make sure that the ensuing steps leading to the finished steel products will be carried out in orderly progression. Ore will be mined and shipped throughout the year, making it unnecessary to build stockpiles, as is the case at eastern mills getting ores from the winter-bound Lake Superior ranges. A rotary dump turns each car over to discharge its load into a hopper, whence it is conveyed underground to an ore-bedding area where ores from different sections of the mine are blended. Traveling Robins stackers spread the material n successive layers—build up long, narrow piles, as shown in accompanying illustrations. These are later sliced down from top to bottom by "reclaimers" that deliver the ore to conveyor belts in concrete-lined trenches running lengthwise between each pair of piles. The belts move it to a screening station, where it is separated into three sizes: large, intermediate, and fine. The fines are conveyed to the sintering plant and the remainder of the ore goes to the blast-furnace ore hoppers.

Incoming cars of coal are similarly handled by rotary dumps and belts that deliver the fuel to a storage area where it is piled by a horizontal tripper conveyor. The coal is so volatile that it will ignite spontaneously if held too long in storage, and it also has a tendency to slack. Consequently, no more than twenty days' supply is stockpiled. Under each pile is a conveyor belt housed in a 15x15-foot tunnel with openings spaced 20 feet apart. The fuel is drawn down as needed, and if heating or slacking starts anywhere in a pile, the section affected can be removed quickly. Conveyors carry the coal first to a hammer mill, where it is reduced in size to ⅛ inch and under, and then to four 400-ton bins where it is mixed with newly received or transit coal. The mixture is transported to two 2500-ton reinforced-concrete bins that supply the lorries that charge the coke ovens.

Coke for operating the blast furnaces is provided by 252 by-product coke ovens arranged in four batteries of 63 each. In most steel-producing areas, coke for blast-furnace use is made from a mixture of coals that gives the fuel the desired properties. For example, in the Chicago district approximately one-third of Kentucky Lynch coal, which has good coking qualities, is mixed with two-thirds of Pocahontas low-carbon, high-volatile coal. At Geneva, however, coke must be manufactured from the one grade locally available. This coal is on the border line so far as coking qualities are concerned, but the resultant coke has been successfully used at Ironton for many years, and the experience gained there will be of value in operating the Geneva blast furnaces.

Modern by-product coke ovens such as those at Geneva utilize the coal completely. The volatiles driven off are piped to the by-products plant and there treated for the extraction of various useful substances. The end product is coke-oven gas, which serves as fuel at different points in the plant. Tests made with Geneva coal, based on an average coking time of 19 hours 52 minutes, have shown that each ton will yield the following by-products: 26.5 pounds of ammonium sulphate, 4.15 gallons of light oil, 2.758 gallons of motor fuel, 0.2 gallon of toluol, 0.017 gallon of light solvent, 3.111 gallons of benzol, 11.56 gallons of tar having 148,300 Btu. per gallon, and 11,500 cubic feet of gas having 582 Btu. per cubic foot.

The Koppers coke ovens are designed for underfiring with gas. Half of them use coke-oven gas as fuel and the other half a mixture of blast-furnace and coke-oven gases. Each is a rectangular chamber holding 14.4 tons of coal and is charged by a lorry that travels on overhead tracks and has three funnel-shaped hoppers that fit into corresponding openings in the top of each oven. After charging, the oven is sealed and heated by burning gas in 28 flues on each side of it, developing a temperature of 2100°F. After approximately eighteen hours all the volatile constituents are driven off, leaving an incandescent pasty mass of coke containing essentially carbon and ash. This is pushed out into a car and quenched. Meanwhile the gas has been steadily flowing off into a collecting main and been drawn from there by exhausters to the by-products plant where the several substances enumerated in the preceding paragraph are extracted in a series of reactions.

The ore charged into the blast furnace is made up of about equal quantities of three sizes: ⅞-1½ inches, 5/16-⅞ inch, and fines of 5/16 inch and under. The fines are sintered before use, this being accomplished by fusing the ore with coke dust or breeze on a traveling belt. Sinter breaks up into relatively large pieces and has sufficient strength to resist crushing under the weight of the furnace charge, thereby aiding the passage of blast air through the stack. For each 2 tons of ore are required ¾ ton of coke and ¼ ton of limestone.

The dust contained in the gas coming from the blast furnaces is recovered by passing the gas successively through a collector, a washer, and an electric precipitator. The resultant sediment is pumped to a Dorr thickener the product of which, incorporated in sinter, reënters the furnaces. The cleansed gas goes to a 1,000,000-cubic-foot holder. The furnaces are tapped at approximately 6-hour intervals. Slag is drawn off on one side and transported in ladle cars to a disposal area; the iron is tapped at the opposite side and transferred to either of two 800-ton-capacity hot-metal mixers from which it is withdrawn as needed to charge the open-hearth furnaces.

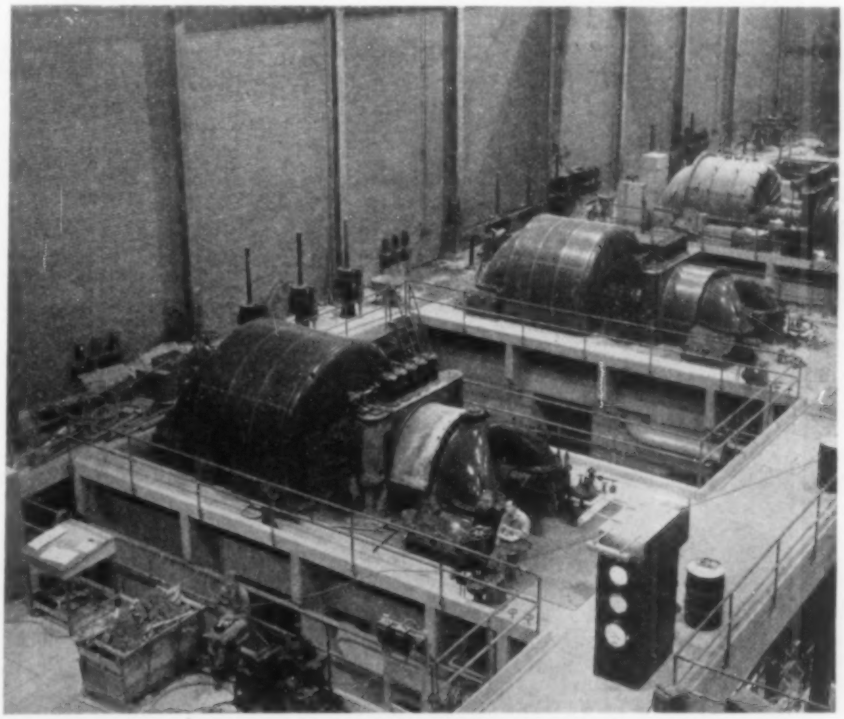
In making steel by the open-hearth process and rolling it into various commercial shapes, approximately 70 per cent of the metal tapped from the furnaces gets into the final products. The other 30 per cent in the form of ingot overflow, ladle residue, mill trimmings, etc., is temporarily lost by the wayside. This represents scrap and goes back into the open hearths. Most mills supplement their own scrap with purchased material and charge their open hearths with around 50 per cent scrap and 50 per cent blast-furnace iron. However, because little scrap is available in the intermountain area, the Geneva plant will use only the 30 per cent that it produces: the remaining 70 per cent of the open-hearth charge will be blast-furnace iron.

About 220,000,000 gallons of water is pumped through the plant daily, and as water is a semiprecious fluid in Utah provisions have been made to reclaim as much of it as possible. To accomplish this, a 312-acre section of nearby Lake Utah has been enclosed within earthen dikes to form a cooling pond 8 feet deep and having a capacity of 785,000,000 gallons. Most of the water for main-plant use will be purchased from the Metropolitan Water District of Salt Lake City and will come from Deer Creek Reservoir. This will be supplemented by springs and wells on the property and by the canal-borne irrigating water that was allotted the farmlands that were purchased as the plant site. Two underground water conduits run between the powerhouse and the cooling pond. One is a return line and the other a feed line to the pumps, and each slopes so as to provide gravity flow.

Water for the boilers and for cooling blast furnaces, open-hearth furnaces, reheating furnaces, and turboblowers is reclaimable after cooling. From the point where it enters the pond it must flow about 2 miles before reaching the intake, and this suffices to cool it to a temperature of from 60 to 65°. Water for services such as gas-washing in the coke-oven by-products plant is unreclaimable. After being clarified to meet public-health standards, it is discharged into Lake Utah, from which it is ultimately withdrawn for irrigating purposes. It aggregates about 20,000,000 gallons daily and is obtained from wells, springs, and drainage. In addition, about 9,000,000 gallons is lost each day from the recirculating system through evaporation, contamination, etc., and an equal volume of make-up water is purchased daily.

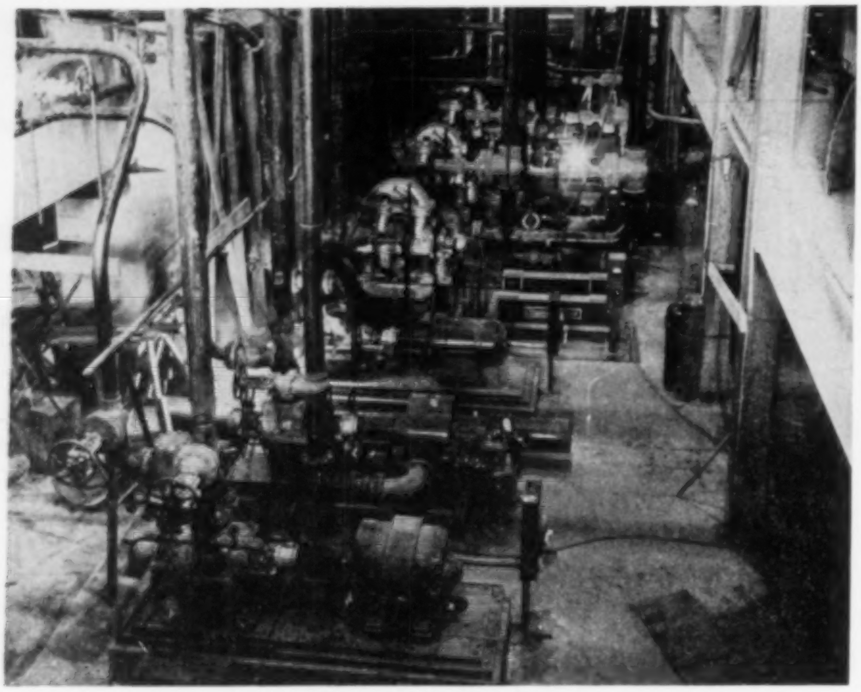
Prior to starting operations, all the water used to fill the cooling pond was softened, and the make-up water added daily is similarly treated in a plant having a capacity of 8300 gpm. Softening and thus keeping the water free of scale-forming salts is said to be an innovation in steel-mill practice. The water is circulated through the plant by Ingersoll-Rand centrifugal pumps. For handling treated water there are three 1250-hp. units, each rated at 23,000 gpm. against 180 feet of head. Two are driven by Elliott turbines and one by a General Electric motor. Two similar pumps, but each rated at 14,000 gpm. against a head of 172 feet, handle untreated water. Each is driven by a General Electric 800-hp. motor.

The powerhouse, which was designed by Sargent & Lundy of Chicago, Ill., is generally laid out like that built at the Chicago South Works of the Carnegie-Illinois Steel Corporation while President Mathesius of Geneva Steel Company was general superintendent there.



TUBOBLOWERS

The blast furnace is so named because a blast of air is blown through the charge of iron ore, coke, and limestone to provide oxygen for combustion. In steel-mill parlance, this blast is called "wind." Three of the four Ingersoll-Rand turboblowers that furnish blast air at Geneva were in place when this picture was taken. Each machine can deliver 95,000 cfm. of air and is driven by an 11,350-hp. steam turbine. Most blowers are built for 30 pounds maximum discharge pressure; but, to meet special conditions at this plant, the units were designed for 35 pounds maximum.



POWERHOUSE PUMPS

These Ingersoll-Rand pumps perform services in connection with five boilers. In the foreground are three units that handle condensate from feed-water evaporator coil drains. Each has a capacity of 296 gpm. against 568 feet of head. Beyond them are three boiler-feed pumps each rated at 1260 gpm. against a head of 1628 feet. Of each set of pumps, two are motor driven and one is turbine driven.

Steam is developed in five Babcock & Wilcox boilers, each rated at 150,000 pounds per hour. Two of them are equipped for firing by coke breeze and blast-furnace gas and the others by coke-oven gas, blast-furnace gas, or pulverized coal.

Power for operating the mill is supplied by a General Electric 50,000-kw. turbogenerator that produces 13,800-volt, 3-phase, 60-cycle current. For greater flexibility, it had been planned to install two 25,000-kw. turbines, but only a single unit was allocated to the plant by the War Production Board. Under normal service conditions the mill will require about 40,000 kw., and the surplus power will be fed into the lines of the Utah Power & Light Company. There will, however, be momentary periods when the demand will be greater than 50,000 kw., and then the plant will draw on the utility-company system.

Also housed in the powerhouse are the turboblowers that furnish combustion air for the blast furnaces. Built to meet the operating conditions at Geneva, these machines differ in some details from those designed to blow furnaces using Great Lakes ores and coke made from eastern coals. Standard blowers for the latter service are rated at 30 pounds discharge pressure, although they can and sometimes do deliver higher pressures for brief periods. The pressure must, of course, be great enough to force air up through the column of ore, coke, and limestone that fills the furnace. In the Chicago and Pittsburgh areas, the normal average operating pressure is around 18 pounds. In the Birmingham area it is considerably higher. Experience gained by Columbia Steel Company at Ironton, where 30-pound blowers have been used, has shown that a pressure of 22 to 27 pounds is needed because the coke has small voids for the passage of air and the ore has a tendency to pack and make a "tight" stack. Based on the data obtained at Ironton, and also to compensate for the altitude of 4500 feet at the Geneva plant, its designers decided upon blowers affording greater reserve pressure than standard machines. Consequently, the units were ordered for 35 pounds maximum discharge pressure, and are the first blast-furnace blowers ever built for that pressure.

There are four of these blowers—one for each of the three blast furnaces and a spare. They were built by Ingersoll-Rand Company in accordance with its regular design, except for the modifications necessary to meet the conditions outlined. Each machine has a rated capacity of 95,000 cfm. at a barometric inlet pressure of 12.45 pounds absolute and an atmospheric temperature of 100°. The blower end has five stages, compared with four in standard units. The driver of each unit is a direct-connected, 12-stage condensing turbine rated at 11,350 hp. at 2820 rpm. when using steam at 450 pounds pressure and 750°F. and with a vacuum on the outlet of 28.5 inches, referred to a 30-inch barometer. Each turbine is served by an Ingersoll-Rand 2-pass surface condenser with 10,000 square feet of cooling surface, with a hot well for reheating condensate by means of exhaust steam from the turbine, and having steel tube sheets. Each unit has two Ingersoll-Rand Class 3-DHW pumps for handling condensate.

The development of mines to supply the Geneva works with ore, coal, and fluxing rock called for sizable auxiliary construction programs. The ore, which is a hematite averaging an iron content of 53 per cent, comes from open-pit workings at Iron Mountain, 25 miles from Cedar City and approximately 225 miles southwest of Geneva. This is the same deposit that furnishes ore for the Ironton blast furnaces of the Columbia Steel Company, and the mining operations are carried on by a subsidiary concern, the Columbia Iron Mining Company. After being drilled and blasted, the ore is dumped by diesel shovels into trucks and hauled to a new crushing and loading plant adjacent to similar structures that have handled ore for some years for the Ironton plant. There it is crushed to a maximum size of 1½ inches and loaded into railroad cars for transportation to Geneva. The Iron Mountain deposit contains reserves sufficient to last 40 years at the current rate of production. About 200 men will be required as a result of the increased mining operations.

Coal of subbituminous grade is produced at the Geneva Mine in Horse Canyon near Price and 130 miles from the steel plant. The seam, which is the same one that is worked by the Columbia Coal Mine 7 miles away, ranges from 10 to 16 feet in thickness. It slopes about 10° from the horizontal and has been opened up by driving entries into it from both sides of the canyon, where it outcrops. The mine is completely mechanized, neither picks nor shovels being used. Shaker conveyors deliver the coal from the mining faces to belt conveyors, and these move it to main haulage drifts where it is transferred to 10-ton cars pulled by electric locomotives. The output from both sides of the canyon is combined and then carried 1300 feet by belt to a crushing plant, where it is reduced to sizes of 12 inches and under. A magnetic pulley removes tramp iron, and the coal is next delivered to a 78-inch conveyor belt that extends 3500 feet through a rock tunnel leading to the mouth of the canyon. There it passes through a breaker, to be further reduced and segregated into the various sizes needed for the Geneva by-product coke ovens and also for 500 beehive coke ovens that were erected near the mine to supply coke for the blast furnace that was transferred from Joliet to Ironton. Beehive ovens, which save none of the by-products, have been outmoded for blast-furnace plants for several decades, but were built in this instance to speed up the production of pig iron.

The mine was opened up by Allen & Garcia Company of Chicago under the supervision of M. V. Whiteman, engineer of the H. C. Frick Coke Company, Pittsburgh, Pa. Auxiliary construction jobs included the building of a 7-mile branch line of The Denver & Rio Grande Western Railroad that involved the removal of 1,000,000 cubic yards of material, largely rock, and of a 7-mile highway to connect the Geneva and Columbia mines that entailed the moving of 200,000 cubic yards of material. Excavation at the Geneva Mine and at the coke-oven site amounted to 500,000 cubic yards.

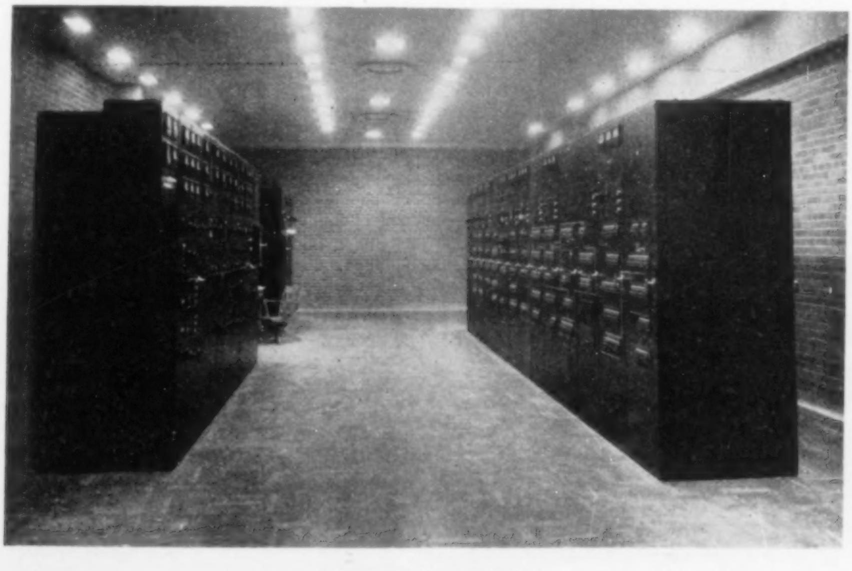
The coal mine will have a daily output of around 8000 tons and will employ about 1000 men. To house them and their families the Government constructed a modern town called Dragerton for Walter L. Drager, chief engineer of the Defense Plant Corporation and a pioneer in Utah reclamation work. Each house has hardwood floors, a central-heating stove, a bathroom, and an electric refrigerator. Limestone and dolomite, used as fluxes in blast furnaces and open-hearth furnaces, are obtained near Payson, some 25 miles from Geneva. Two quarries opened up there employ about 50 men and have been named for the late C. T. Keigley, formerly superintendent of the Columbia operations at Ironton. The stone is produced by methods similar to those practiced at the iron mine.

INTERIOR OF MAINTENANCE SHOP

This is claimed to be the best-equipped structure of its kind west of the Mississippi River. It combines under one roof complete facilities for repairing and maintaining any machine or appliance in the plant. It is a necessity because of the remoteness of Geneva from the eastern centers where most of the equipment was made. The building is windowless and air conditioned, and the artificial illumination is designed to provide the most favorable visual conditions in all working areas.

Following the pattern that was used in assembling the men to build the new plant, United States Steel likewise drew from its experienced personnel when it came to setting up an organization to operate the Geneva works. Mr. Mathesius, who heads Geneva Steel Company, was previously vice-president of the United States Steel Corporation of Delaware in charge of operations of all subsidiary companies. He has been with the corporation since 1911 and has served, among previous assignments, as general superintendent of the South Works of Carnegie-Illinois Steel Corporation at Chicago and later as manager of all operations of the same concern in the Chicago district. Robert G. Glass, vice-president and manager of operations for Geneva, has been assistant manager of operations for Carnegie-Illinois in the Chicago area. J. R. Gregory, vice-president and manager of sales, previously held a similar title with Columbia Steel Company. J. E. Butler, controller, and J. Wohlwend, treasurer, also served the Columbia organization for many years. Merrill Russel, secretary and general attorney, has been a member of the law firm that acts as Chicago division counsel for Carnegie-Illinois and has been identified with the legal work involved in the construction of the Geneva plant.

The making of coke on December 14, 1943, marked the beginning of operations, which came twenty months after the clearing of the site was started in April, 1942. The production of iron and steel was scheduled to begin soon afterward, and by the time this article is printed all the departments but the rolling mills will probably be functioning. The rolling of ship plates will start as soon as the erection of the necessary equipment can be completed.

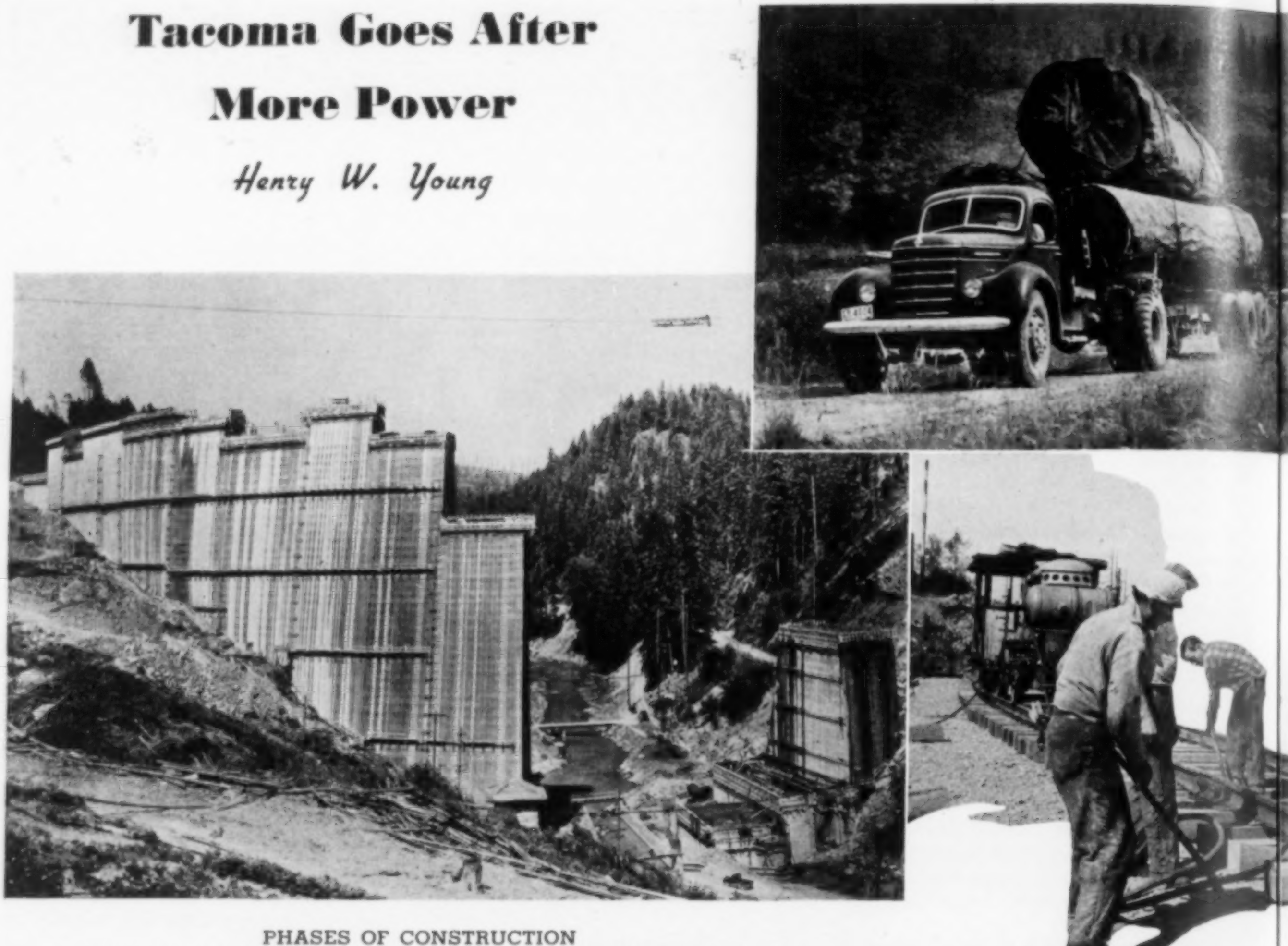


REMOTE CONTROL

Instead of having a local operator at each substation and a local attendant in each mill motor room, those at the Geneva works are controlled from this room by one man. The Westinghouse supervisory control system used has served central-power generating stations since 1921, but the present application is by far the most extensive one yet made of it in the steel industry. Eleven control centers and approximately 500 control points are supervised from the control desk, and space is available for 200 more points in case of expansion. The practical effect of the system is to reduce the operating personnel by from 25 to 30. Other electrical equipment provides for dispatching steam, water, and blast-furnace and coke-oven gases throughout the works. Thus two men, stationed in a windowless, air-conditioned switch house, will at all times have a complete picture of the plant's operations on the electrical boards in front of them. If necessary, the entire works can be shut down and blacked out in less than a minute.

Tacoma Goes After More Power

Henry W. Young



PHASES OF CONSTRUCTION

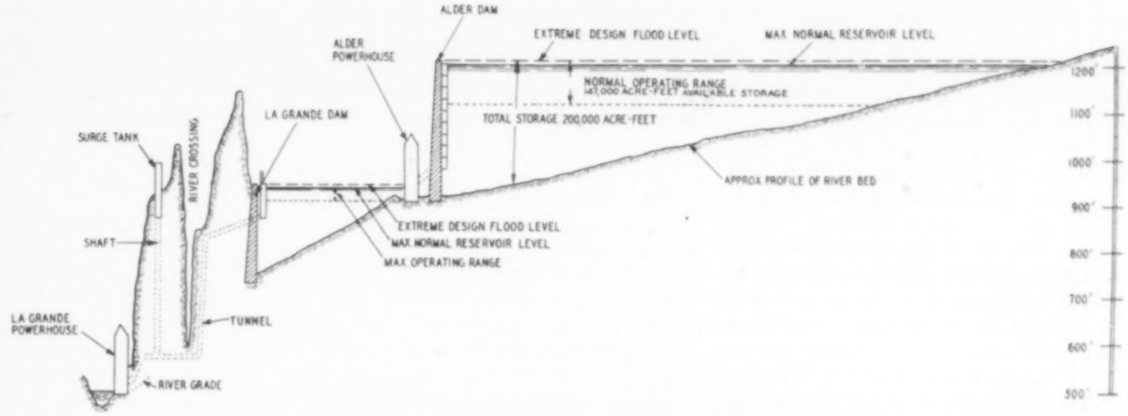
Illustrated above is Alder Dam, which will rise 320 feet from the lowest bedrock and have a crest length of 1600 feet. The picture was taken from upstream in July, 1943, before concrete had been poured in the river section. Clearing of the reservoir area developed into a sizable lumbering operation. The top-center view shows logs being hauled to the sawmill. Downstream from Alder Dam is LaGrande Dam, seen under construction at the extreme right. It will be 217 feet high and contain 100,000 cubic yards of concrete. In the bottom picture, men are drilling grout holes in a gallery in LaGrande Dam. Fourteen miles of railroad tracks that follow the Nisqually have to be relocated. The air-driven spike driver shown in the center is speeding up the rail-laying job. Air for this as well as other work is furnished by the portable compressor in the rear. The unit is mounted on railroad car wheels. The drawing illustrates the whole development in profile but somewhat distorted because the scale in the vertical plane is about 26 times as great as that in the horizontal plane.

FOR fifty years Tacoma, Wash., has been in the business of generating, purchasing, and distributing electrical energy, marketing it for domestic, commercial, industrial, and governmental use. This has been confined principally to the city itself, although it has statutory authority to sell to others outside its limits. The power is vested in the Department of Public Utilities, at present headed by R. D. O'Neil, commissioner, and exists under and by virtue of the Freeholders' Charter of the city. The department operates the Water Division, Belt Line Division, and Light Division.

The Tacoma Light Division, under the able management of Verne Kent, superintendent, serves more than 40,000 customers, as well as six towns and public-utility districts and seven mutual and coöperative light utilities; and wherever the pros and cons of municipal ownership have been discussed in recent years the accomplishments of Tacoma have generally been held up as an outstanding example. From 1940, when the city obtained 68,959,000 kw.hrs. of electricity from outside sources, to 1943, when an estimated 396,000,000 kw.hrs. was bought, the block of energy so acquired has risen on a fairly even scale. These purchases have been made to supplement the power produced by Tacoma's three hydroelectric and two steam plants. The purchased power has been procurable on a strictly "if, as, and when available" basis, and has been surplus energy.

To meet its firm-power obligations in the future, it became evident that the city would either have to develop its own low-production-cost hydroelectric facilities or contract to buy higher-cost firm power, with a resulting decrease in operating revenue. In view of the demand for more and more low-cost energy, recommendations favoring the further expansion of Tacoma's hydroelectric facilities were made as early as 1938. Studies of several locations finally culminated in the selection of a site on the Nisqually River about 35 miles from Tacoma.

On April 15 and June 4, 1942, contracts were signed with the L. E. Dixon Company of Los Angeles, Calif., and the West Construction Company of Seattle, Wash., respectively, for the major features of what is known as the Second Nisqually Power Development. In May, 1943, the engineering firm of Charles T. Main, Inc., of Boston, Mass., was retained by the city to supervise and expedite the project, and J. J. Downey, chief engineer for Main & K. C. McFarland, civil and hydraulic construction engineers, is located in Tacoma on this work. The estimated total cost of the undertaking, including construction contracts, equipment, materials, etc., is approximately $19,000,000.


ALDER DAM
EXTREME DESIGN FLOOD LEVEL
MAX NORMAL RESERVOIR LEVEL
ALDER POWERHOUSE
NORMAL OPERATING RANGE
147,000 ACRE-FEET AVAILABLE STORAGE
TOTAL STORAGE 200,000 ACRE-FEET
LA GRANDE DAM
SURGE TANK
RIVER CROSSING
APPROX PROFILE OF RIVER BED
SHAFT
EXTREME DESIGN FLOOD LEVEL
MAX NORMAL RESERVOIR LEVEL
MAX OPERATING RANGE
LA GRANDE POWERHOUSE
TUNNEL
RIVER GRADE
1200'
1100'
1000'
900'
800'
700'
600'
500'

It will be noted upon inspection of the accompanying map of the tortuous Nisqually and of the profile of the river bed that the project is far from being just another dam and power plant. On the contrary, it is an intricate job involving no less than eight distinct factors. An arch-type gravity dam is being built about 1¾ miles above the present LaGrande powerhouse, where 24,000 kw. is now being developed from stream flow alone. This is known as Alder Dam, which will create a reservoir with a total capacity of 200,000 acre-feet. The adjacent power plant will generate 50,000 kw. under a gross head of 265 feet. This is the first use made of the impounded water, the "end use" being downstream at the LaGrande powerhouse where a new unit of 40,000 kw. will be installed in an addition under construction, bringing that station up to 64,000 kw. The total power to be supplied by the Second Nisqually project is therefore 90,000 kw.

At this point a nice problem of design arose. One solution was to dig a new draft-tube tunnel of sufficient capacity to convey the water at LaGrande back to the spillway at Alder Dam, a distance of nearly 2 miles. The alternative was the building of a dam about halfway between Alder Dam and the present powerhouse, creating a small reservoir to be tapped by a shorter tunnel extending to that powerhouse. (No power is being developed directly at LaGrande Dam.) It so happened that the cost estimates under the two plans were a tossup, so LaGrande Dam was decided upon because of the following important consideration. The take-off of the new tunnel from LaGrande Reservoir will be at the same elevation as that of the headworks of the old tunnel. Therefore, the present generating equipment can be kept in operation without any changes during the construction period and thereafter by the simple expedient of providing the existing penstocks with new manifold connections. Ultimately the old tunnel will be plugged.

Another piece of work in connection with the project is the relocation of a freight and logging line maintained by the Chicago, Milwaukee, St. Paul & Pacific Railway. This necessitates moving a 14-mile, single-track section out of the river canyon, across a flat, and back again to the Nisqually at Elbe. Incidentally, the new route is an improvement both as to grade and line. At the present time the road runs through Alder Dam site, and the pouring of blocks 31 and 32 will have to be postponed until the railroad has been shifted sometime early this year. The contractor on the job is Strong & McDonald of Tacoma. By an agreement between the city of Tacoma and the state of Washington, the latter pays 30 per cent of the cost of 2 miles of highway relocation, the reason being that the state desires the replacement of that stretch of road by one at a higher grade. The state has let the contract for the work to Nilson-Smith Contracting Company of Great Falls, Mont., and is supervising it.

Situated in the new reservoir area above Alder Dam was Alder, a typical logging town with more past than future. Even so, it numbered several hundred inhabitants and boasted a school, a church, a post office and store, and a garage. The property has been bought by Tacoma, which has moved the school and church half a mile to higher ground, where it will also build a store and post office, all to become the nucleus of a new community. The other structures at the old site will be wrecked and disposed of.

Not so simple, however, was the clearing of the remainder of the reservoir area, which is very irregular in shape, roughly 3 miles long, and averages half a mile in width. Being largely covered with heavy fir trees, it was decided to fell the timber with city forces and to cut the logs into lumber. Three saw mills were therefore erected and have already produced most of the rough wood required for the dam construction, as well as the ties for the railroad relocation. It is conservatively estimated that, when the salvage value of the mills is taken into consideration and the lumber available for the open market has been sold, the profit to the city will be upwards of $75,000. After the usable timber has been cut, the area will be cleared and the slashings burned. Some of the large logs in inaccessible places will be floated out to the mills later when the reservoir is filled.

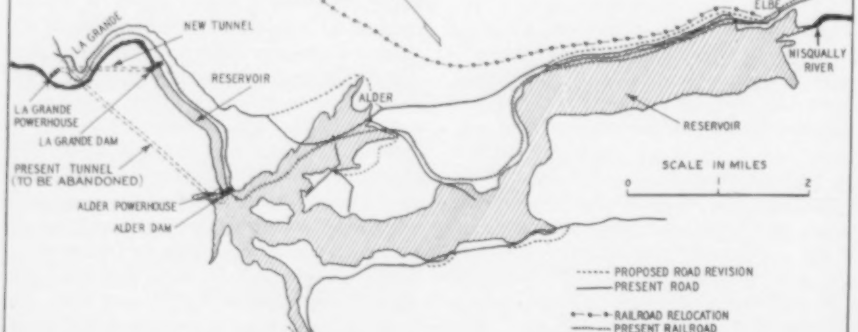
The largest single unit is Alder Dam. This, together with LaGrande Dam and Alder powerhouse, constitutes the Dixon contract, which is just under $6,000,000. The first-named structure will rise 320 feet above the lowest bedrock, will be approximately 1600 feet long, and will contain 400,000 cubic yards of concrete. Compared with the millions of cubic yards that have gone into Grand Coulee, Shasta, Boulder and other prewar monoliths, it does not rate large. However, it is fairly comparable in height, and height spells water pressure. Therefore, in building Alder Dam, the same extraordinary precautions have to be taken against failure due to such pressure. These include high-pressure grouting to fill every crevice in the underlying rock and to form an impervious curtain several hundred feet below the foundation; erection of the structure in blocks that are cooled artificially by circulating water through pipes laid in them; and grouting between blocks.

Two steel penstocks, 10 feet in diameter and extending through the dam, will deliver water to two 34,500-hp. turbines in the powerhouse to be constructed immediately downstream. The generators will be of 25,000 kw. capacity each. Excess water at Alder will be carried off by a spillway. This, together with the water from the power plant, will flow into the smaller reservoir formed by LaGrande Dam about a mile below. The latter will be of the straight, gravity type, will be 217 feet high, and contain 100,000 cubic yards of concrete. It will serve merely to divert the flow into the tunnel leading to LaGrande powerhouse. The dam also will be provided with an overflow spillway and with a roadway on top for possible future vehicular traffic.

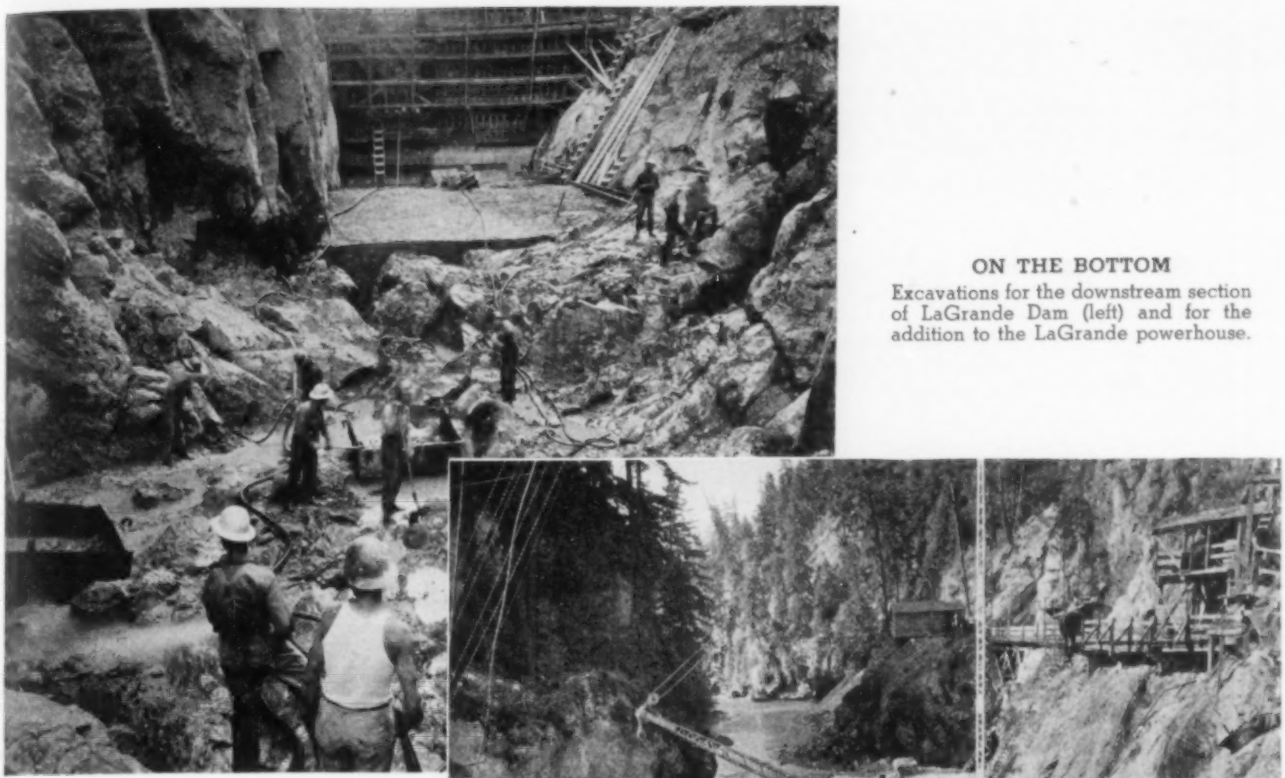
First on the program of the Dixon Company was the excavation of about 60,000 cubic yards of common and 86,000 cubic yards of rock foundation for the dams and power station. The underlying rock is mostly a black andesite, and all drilling was done with I-R Jackhamers and Jackbits. Economic factors in connection with the use of the latter were emphasized under wartime conditions, the saving in steel tonnage and in labor being doubly significant. Blasting was done with du Pont powder, and the material was loaded by a 37-B Bucyrus-Erie and two 603 Lima shovels into dump trucks for transportation to spoil banks downstream from the sites and on both sides of the river. Approximately 15 feet of overburden on the west bank of the Alder site was removed by tractor-drawn, 12-cubic-yard carryall scrapers. These were also used to prepare the foundation for the Alder Dam cableway traveling tail tower and for some 2½ miles of standard-gauge railway spurs to the Alder Dam concrete mixing plant and the gravel processing plant.

The gravel washing and screening plant has a capacity of 270 tons per hour. It is located about 5 miles upstream from Alder Dam on a river-deposited bar approximately 100 acres in extent and containing excellent aggregates to an average depth of 10 feet. Most of the raw material is dug by a dragline loading into two 50-ton, bottom-dump ore cars pushed alternately to a hopper adjacent to the screening plant by a 20-ton Plymouth locomotive. Coverage of most of the pit is assured by 2500 feet of track converging upon the hopper. Because the pit is not consistent in sand and gravel, a second dragline operates in the sandy area in conjunction with dump trucks which discharge their loads into the same hopper.

The washing and screening plant is notably modern and built around a revolving scrubber-screen, 60 inches in diameter and 27¾ feet long, made up of three sections: a 4-foot plain scrubber, a 14-foot section of 3-inch mesh, and a 9¾-foot section with 6-inch openings. A 30-inch conveyor belt, 320 feet long, feeds the raw material from the pit hopper to this screen, whence it is further separated by screens of 1¼- and ¼-inch mesh into pea gravel and sand. Oversize rock passes successively through a Universal jaw crusher and a Traylor type secondary crusher. Water for the plant is pumped from the river through 600 feet of 6-inch pipe line by a 125-hp. centrifugal pump.



PLAN DRAWING OF DEVELOPMENT



ON THE BOTTOM

Excavations for the downstream section of LaGrande Dam (left) and for the addition to the LaGrande powerhouse.

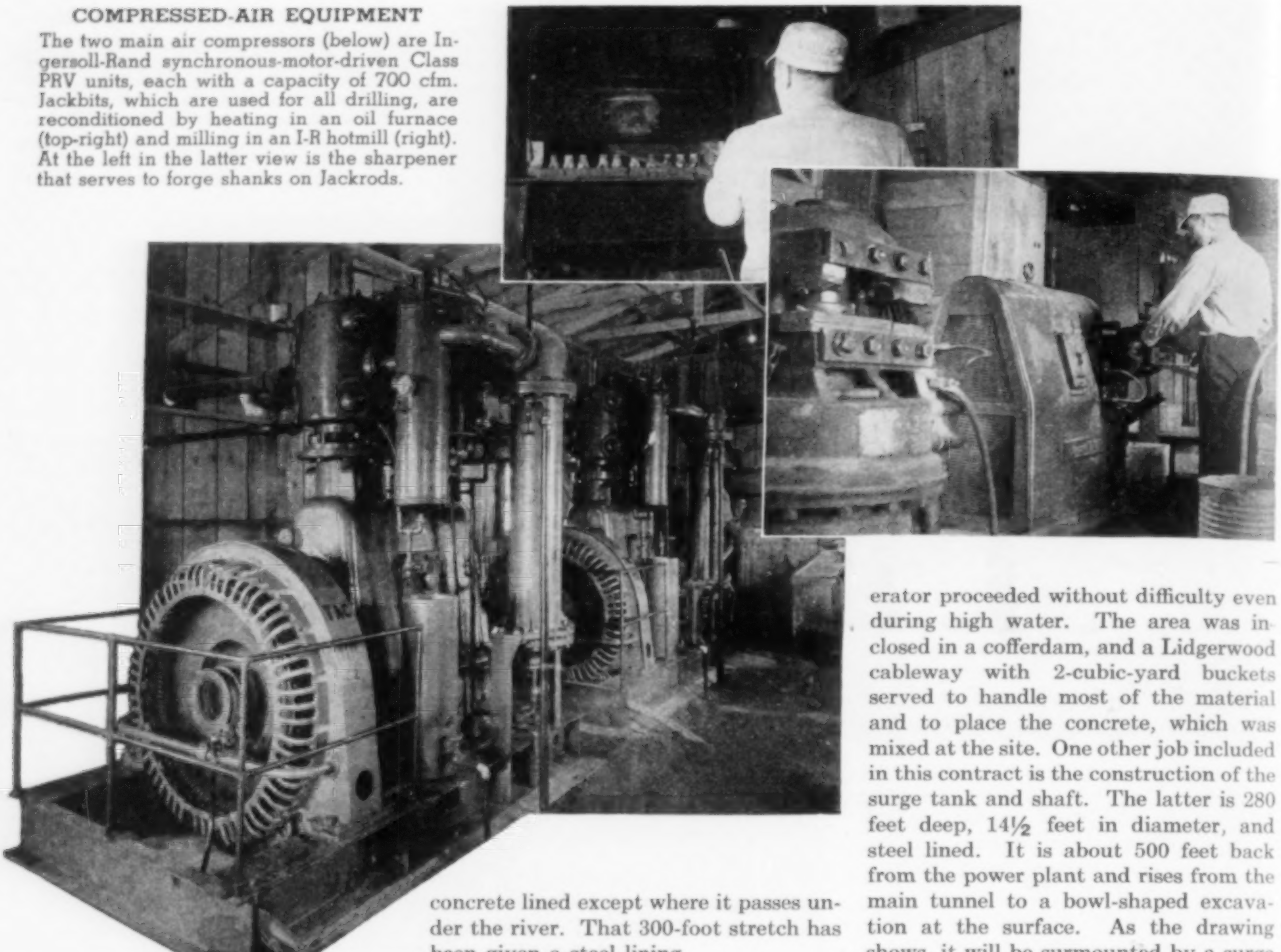
At both dam sites, conveyor belts carry the aggregates from storage bunkers to overhead bins at the mixers. At Alder there is a 4-compartment bin of 750 tons capacity served by a belt some 600 feet long, and the two 4-cubic-yard mixers are charged by a single accumulative-type aggregates batcher. Sand and water are weighed in separate batchers. Mixing time is controlled by meters. At LaGrande Dam the single 2-cubic-yard tilter mixer is surmounted by 200-ton bins fed by a belt about 300 feet in length. Batching equipment is similar to that at Alder. Both plants are automatically controlled by electronic-tube cutoffs.

The mixers dump into circular concrete buckets, those used at Alder being 8 cubic yards in capacity and those at LaGrande 4 cubic yards. Each full bucket is shuttled out to the dam site on a flat car pushed by an electric locomotive. There a cableway sets an empty on the car and picks up and delivers the loaded bucket, the empty then being transported back to the mixing plant. In the case of Alder, the buckets are conveyed to any part of the dam, spillway, or powerhouse by a single 20-ton cableway, with a 2000-foot span, anchored to a fixed 100-foot tower at the mixing-plant end and to a 110-foot-high self-propelled tower at the other end. The latter tower travels on two standard-gauge tracks laid in an arc and on 58-foot centers. The front track is on a slope normal to the front legs of the tower to assure the necessary thrust, while a heavy concrete counterweight carried on the rear tower legs prevents overturning. The hoist at the base of the fixed tower is operated by a 500-hp. motor, and the traveling tower is propelled by a 100-hp. motor that is actuated by the hoistman by remote control. A 10-ton, 300-hp. Lidgerwood cableway with an 832-foot span conveys the concrete buckets at LaGrande Dam. The ends of the 2½-inch lock-coil cable are attached to low, steel towers that travel on paralleling double tracks 200 feet long.

Diversion of the Nisqually River at Alder Dam was accomplished by building a concrete wall around two of the four concrete blocks of the river-bed section of the structure. In one of these is a 15x33-foot opening through which the water will be diverted while the other river blocks are being poured. Upon completion of the entire project the opening will be closed by an 87-ton sliding gate the guides for which form an integral part of the upstream face of the dam. No stream-diversion problems were encountered at LaGrande Dam, the single block on the river bottom having been placed during extreme low water in the summer of 1942. All this

COMPRESSED-AIR EQUIPMENT

The two main air compressors (below) are Ingersoll-Rand synchronous-motor-driven Class PRV units, each with a capacity of 700 cfm. Jackbits, which are used for all drilling, are reconditioned by heating in an oil furnace (top-right) and milling in an I-R hotmill (right). At the left in the latter view is the sharpener that serves to forge shanks on Jackrods.



work of the L. E. Dixon Company comes under the field supervision of K. L. Parker, chief engineer, and W. N. Evans, general superintendent.

To the West Construction Company of Seattle was awarded the contract for digging the 6400-foot tunnel that will conduct the water from the LaGrande Dam to the existing LaGrande powerhouse and its extension, which the company is also building. The total amount of the West contract is $2,138,802.02. As previously stated, this tunnel will eventually replace the present smaller tunnel now leading to the power plant from the small headworks diversion dam just upstream from the new Alder Dam. When Alder reservoir is filled the old headworks will be submerged.

The profile drawing shows the course of the new tunnel, but as it is considerably distorted, the grades indicated are nowhere near true. Actually, the two end sections of the bore are on a 2 per cent grade and the connecting section on a 45 per cent grade, the difference in elevation between the intake of the tunnel and the intake of the existing penstocks being approximately 300 feet. The bore is circular in cross section and has a finished diameter of 14½ feet. It is concrete lined except where it passes under the river. That 300-foot stretch has been given a steel lining.

The method of tunneling was as follows: First a short adit was driven at the lower end from which to advance the tunnel proper to the foot of the steep incline. In the meantime the upper section was excavated to a point close to the top of the incline from another adit. The remaining section was then completed by driving a raise, the muck being removed by way of the lower adit and hauled a short distance to disposal areas along the margin of the river. Inasmuch as the grade was not sufficient to permit the material to slide down by gravity alone, a dragline and scraper were employed to facilitate its flow.

In advancing the lower adit and tunnel section the contractor was able to employ conventional equipment such as a drill carriage mounting five to seven Ingersoll-Rand DA-35 drifters using Jackbits. Blasting was done with 40 per cent du Pont gelatin, and a Conway mucker loaded the spoil into 5-cubic-yard cars hauled by storage-battery locomotives. The concrete lining was steel reinforced and placed pneumatically with concrete guns, wooden forms being utilized for the invert and Blaw-Knox collapsible steel forms for the upper half or arch.

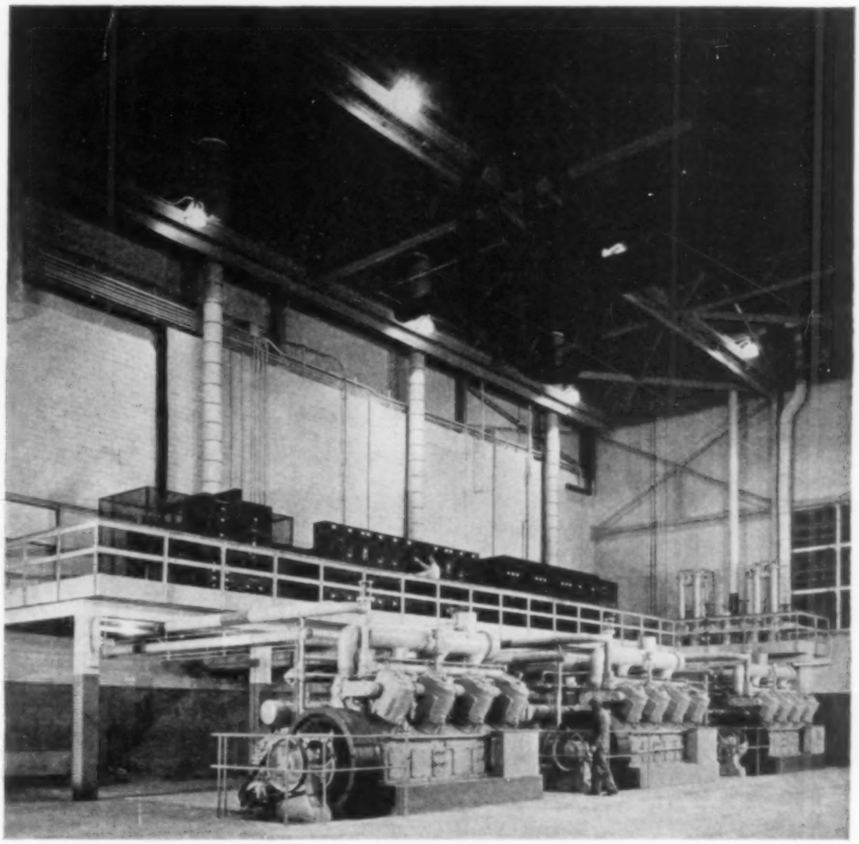
The excavations for the LaGrande powerhouse addition and the draft-tube entrance for the new 40,000-kw. generator proceeded without difficulty even during high water. The area was inclosed in a cofferdam, and a Lidgerwood cableway with 2-cubic-yard buckets served to handle most of the material and to place the concrete, which was mixed at the site. One other job included in this contract is the construction of the surge tank and shaft. The latter is 280 feet deep, 14½ feet in diameter, and steel lined. It is about 500 feet back from the power plant and rises from the main tunnel to a bowl-shaped excavation at the surface. As the drawing shows, it will be surmounted by a surge tank, 109½ feet high and 40 feet in diameter, that will equalize any undue surge pressures that might otherwise develop in the tunnel and penstocks. The West Construction Company, which has about completed this phase of the project, is headed by H. E. Carleton, president. In direct contact with the job have been Ernest Penn, general superintendent; Frank Young, tunnel superintendent; William Hughes, electrical superintendent, and Ernest Moody, shop foreman.

The city of Tacoma has been negotiating for the necessary generating equipment, and on November 29 it was reported that the War Production Board and the Production Urgency Committee had approved the purchase by the municipality of one complete 25,000-kw. unit for the new Alder powerhouse and those parts of the second one of the same capacity that have to be embedded.

Although the 90,000 kw. of electrical energy to be supplied by the Second Nisqually Power Development will no doubt be available before the war ends, still the project was not planned just to meet an emergency. It is in keeping with the city's growth; and, judging by past records and careful estimates of future requirements, the demand for power can be counted upon to increase fairly regularly at the rate of 10 per cent annually.

Gas-Engine Units Compress Air and Generate Electricity

W. M. Gebo



DUAL-PURPOSE MACHINES

Although they are primarily air compressors, these gas-engine-driven machines have generators built into their flywheels to provide emergency lighting current throughout the plant in case of failure of the regular power supply. The three larger vertical pipes against the left wall are the exhaust lines from the gas engines and were placed there to avoid interfering with an overhead traveling crane. On the mezzanine, at the left, are the main switchgear for the boiler house, the control switchgear for the main substation, and the automatic generator switchgear. At the right end of the mezzanine are the vertical aftercoolers for cooling and removing moisture from the compressed air.

WITH our entry into the World War, it was apparent that our manufacturing facilities would have to be expanded greatly and within a relatively short time to meet the requirements of our fighting forces. It was realized that we could contribute the instruments of warfare with greater safety than our Allies, since we were at great distances from the actual conflict areas and out of range of enemy air armadas. In drawing up our production plans, allowances for losses had to be considered owing to the hazards of long supply lines and to the constant threat of submarine activities.

To meet these conditions, government agencies were set up to aid in expanding the production of basic materials, as well as to provide facilities to process them and plants to fabricate and assemble them into finished products for our fighting forces and our Allies. Probably no one industry saw more development than the airplane industry, with its quotas of more than 100,000 planes a year. Any article can cover only a very small part of this expansion, and this account deals with the compressors used in one of the large plants built in the Midwest under the supervision of U. S. Engineers and operated by the Douglas Aircraft Company, Inc. The Austin Company of Cleveland, Ohio, designed and engineered the project, and construction was handled by subcontractors.

After being informed by Douglas as to the compressor capacity that would be required, Austin Company engineers selected both electric- and gas-engine-driven units. It was planned to put the completed parts of the plant into operation as the work progressed, and this made it necessary to locate some of the machines in the plant area proper. The natural selection for the service was electrically driven compressors because of their compactness and relatively quiet operation. Government specifications for plants of this type served by local power facilities call for the partial installation of standby generating equipment to serve in case of power interruptions. Such equipment is usually operated by oil, gas, or steam, depending upon local conditions.

The plant under discussion is in a section having an assured supply of natural gas, and upon learning that flywheel-type generators can be adapted to direct-connected gas-engine compressors and that the units can be used to provide either electricity or air, The Austin Company selected gas-engine equipment to supply most of the compressed air. With a power outage there would be no need for compressed air, and with the power on there would be no need for generating electricity, so a saving was made in critical war material as well as in construction. In both cases only compressors were considered that have proved themselves in service as having high efficiencies and inherent characteristics suitable for this type of installation.

For both purposes the engineers of The Austin Company chose Ingersoll-Rand compressors having unit capacities of 1500 cubic feet of free air per minute at 100 pounds discharge pressure. The electric compressors, of which there are two, are 23&14x16 Type PRE, 2-stage, horizontal, duplex machines with 5-step clearance control and with horizontal-type intercoolers mounted over the compressor cylinders. Each unit is driven by a General Electric 300-hp., 225-rpm., 4100-volt, 3-phase, 60-cycle, 80-percent-leading-power-factor synchronous motor with a full-voltage starting panel. In addition, each compressor is provided with a VM-2 aftercooler with automatic condensate traps, a 4½x14-foot air receiver, and an American automatic, self-cleaning air filter.

The gas-engine-driven machines, three in number, are 300-hp., 350-rpm., Type 8-PXVG-2 units. Each has eight power cylinders of 11-inch bore and 12-inch stroke mounted in a vertical V, and two 15½-inch-bore, 12-inch-stroke low-pressure compressor cylinders and two 10-inch-bore, 12-inch-stroke high-pressure compressor cylinders having a 5-step, free-air unloading system. The compressor cylinders are horizontally disposed and have an intercooler mounted transversely over them. Each machine is fitted with a 200-kw., 80-percent-power-factor, 360-rpm., 4160-volt, 3-phase, 60-cycle, flywheel-type generator with a belt-driven, 250-volt, direct-current exciter.

Complementary equipment for the engine-driven compressors consists of two VM-2 aftercoolers with automatic condensate traps; of two 5x14-foot air receivers; and of an American automatic self-cleaning, intake air filter. A combination gasoline-engine and electric-driven compressor furnishes starting air at 250 pounds gauge pressure and discharges into a 3x8-foot receiver. Other equipment to complete the installation includes a shell-and-tube-type heat exchanger for the water circuit, Burgess exhaust silencers, and American Cycoil oil-bath engine air filters. The Nelson Electric Company supplied a switchboard for use with the emergency flywheel-type generators.

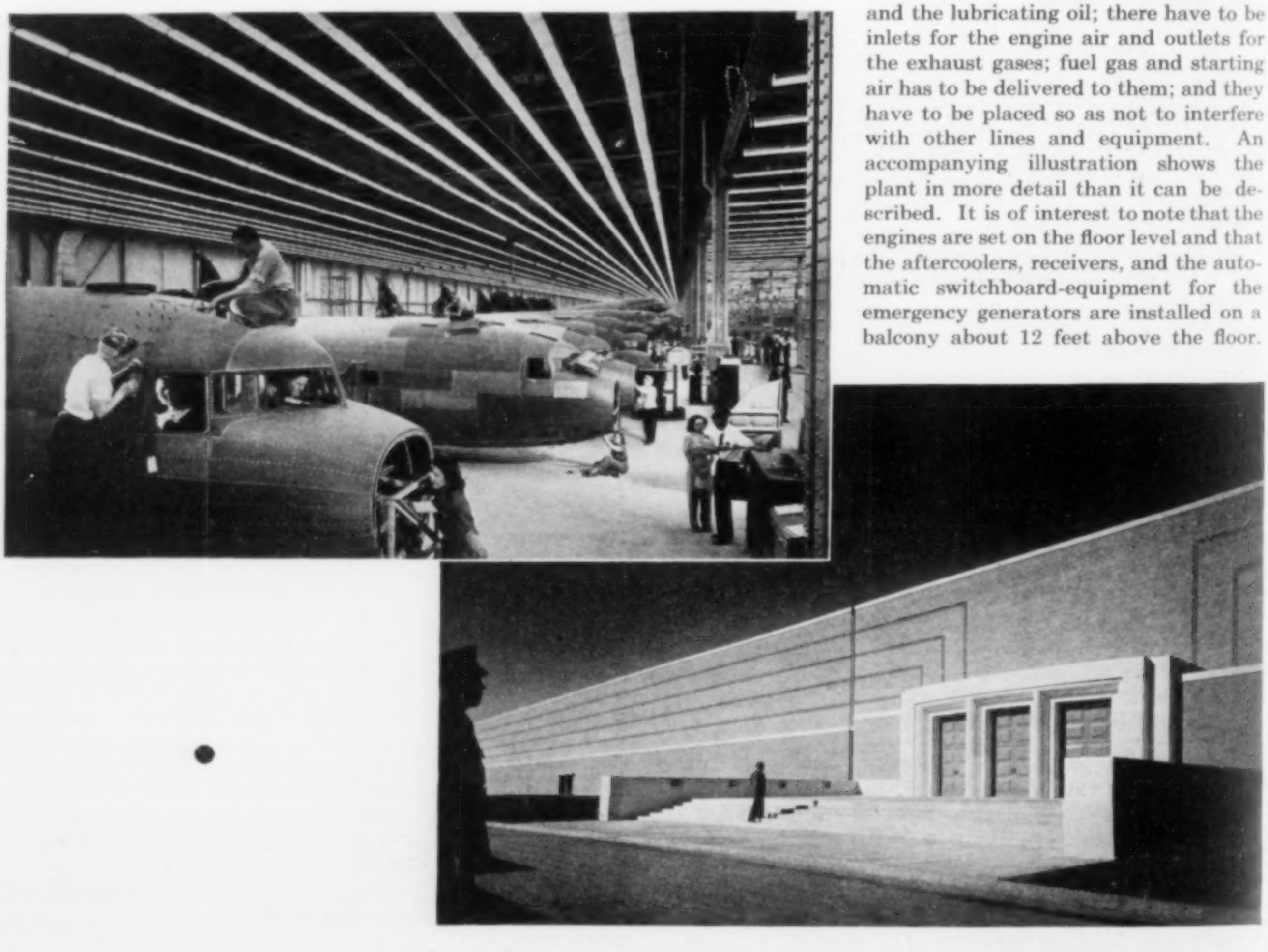
No particular problem was involved in installing the electrical compressors. Each unit was set up complete with its own switchboard, receiver, aftercooler, gauges, and air filter in a separate location—one at the north end of the main plant area and the other at a central point. All possible safety provisions were made, including valves to guard against excessive pressure and automatic devices to shut down the machines in case of power interruption or excessive temperature. The use of intake air filters and aftercoolers assures the delivery of clean dry air to the plant tools to keep them working at full efficiency and without costly maintenance.

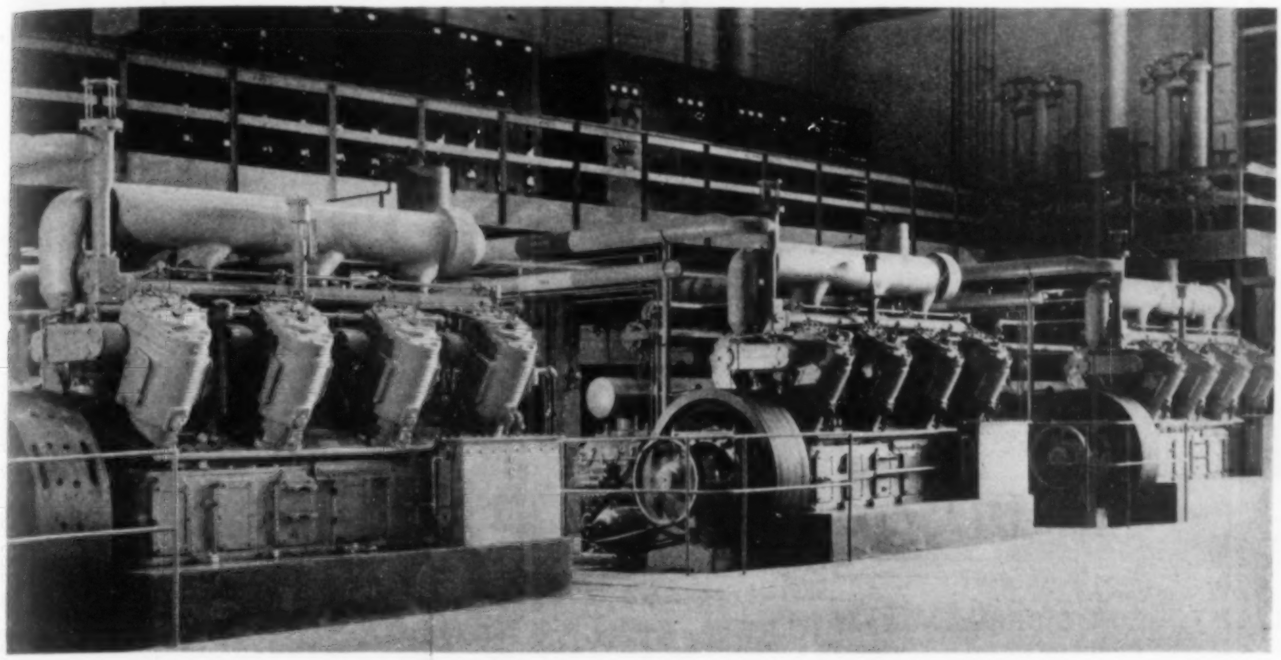
The 5-step clearance control of the electric compressors is operated off the main air-discharge lines and varies the output of each machine through the range of full-, ¾-, ½-, ¼-, or 0-load, according to the demand for air. Features of these units, that are well adapted for this type of installation, are their totally enclosed construction, with all covers and inspection plates securely bolted in place; full force-feed lubrication with shutdown devices that function in case of low oil pressure or overheating; and main bearing micrometer adjustments on the outside that can be locked. As the machines are in the general factory area, these features constitute added safety measures and eliminate the hazards that might otherwise be brought about through tinkering by irresponsible persons.

The setting up of the gas-engine-driven compressors in the powerhouse presented a more difficult problem. When installing gas engines, provisions have to be made for cooling the engine water and the lubricating oil; there have to be inlets for the engine air and outlets for the exhaust gases; fuel gas and starting air has to be delivered to them; and they have to be placed so as not to interfere with other lines and equipment. An accompanying illustration shows the plant in more detail than it can be described. It is of interest to note that the engines are set on the floor level and that the aftercoolers, receivers, and the automatic switchboard-equipment for the emergency generators are installed on a balcony about 12 feet above the floor.

ADMINISTRATIVE BUILDING AND PLANT VIEW

The 2-story, windowless administration building (bottom) is 700 feet long and contains 17,500,000 bricks that were made locally and trucked to the site. The walls contain no steel other than trussed ties that hold the many layers together and make them shatter-resistant. The ties also keep in place a 4-inch blanket of insulating rock wool. Open joints in certain brick courses house hollow-tile flues that distribute air and permit the insulation to "breathe." This unprecedented design has the same insulating value as an 80-inch brick wall. A 12-inch main delivers compressed air to the manufacturing section and is fitted with numerous drains to remove moisture that may condense in it. The more than 20 miles of continuous fluorescent lighting fixtures have reflectors of masonite surfaced with synthetic enamel. Their use saved 170 tons of steel. This plant produced its first transport plane within a year after ground was broken.





CLOSE VIEW OF GAS-ENGINE-DRIVEN UNITS

By using the 5-step unloading system to regulate the compressor output in accordance with demand, the machines operate at a constant speed of 350 rpm. As the generator is of the flywheel type it also operates at a constant speed of 350 rpm., but when air is being compressed it does not deliver any current because the generator field is then not excited. The exciter, being belt-driven, likewise functions when the unit is operating, but the excitation current is isolated by the switchboard.

In case of a power outage, a holding coil drops and puts full line air pressure on the free-air unloaders, thus unloading the compressor. At the same time, another circuit is closed, allowing the generator field to be excited and the unit to start delivering current to the lighting circuits. This changeover is entirely automatic and rapid, taking approximately two seconds. When the power comes back on, the generator is deënergized, the unloading valves are put in the load position automatically, and the unit begins to pump compressed air into the system.

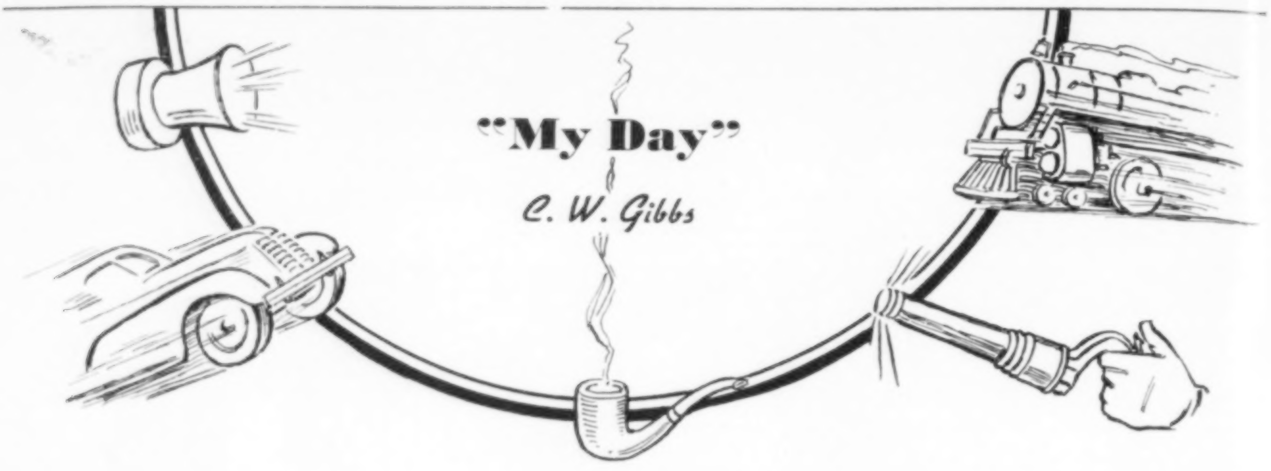
Because the unloader valves on the compressor end are operated at main-line pressure, an auxiliary line from the starting-air system is provided to assure full line pressure on the unloading valves at all times, even though there should be a long power outage. Since the starting-air system is maintained at 250 pounds pressure, a reducing valve delivers air at about 80 pounds to this auxiliary line. The combination starting-air unit is normally motor-driven, but in the event power is not available the gas engine can operate the compressor. Conversion from one type of driver to the other is made by changing V belts. The compressor is mounted in the center, the base plate being extended to hold the motor at one end and the gasoline engine at the other.

The water cooling system is of the closed type and circulates treated water free of solids or scale-forming substances in the water jackets. A separate heat exchanger of the tube-and-shell type is mounted directly over the horizontally disposed intercooler above the compressor cylinders. A pump built into the engine circulates the water through the engine jackets, where heat is absorbed; then through the tubes in the heat exchanger, where heat is given up; and then back to the engine. Cooling-tower water is circulated around the tubes in the heat exchanger, absorbing heat from the engine water and dissipating it through the plant cooling tower. By controlling the quantity of cooling-tower water passing through the heat exchanger, temperature differences on the engine side are kept low (within about 10°F.), with 150° at the inlet to the power cylinders and 160° at the outlet. This close range maintains an even temperature throughout the engine and eliminates any strains or stresses that might lead to damage and resultant costly repairs.

As it is desirable to keep the oil temperature down to approximately 125°, a separate cooling system is operated for that purpose off the main-plant system. The flow of water through the cooler is controlled and maintains the oil temperature within the desired limits. The oil that circulates through the engine is kept in proper condition by a bauxite-type filter furnished by the Peco Filter Company of Dallas, Tex. A small quantity, about 1 gpm., is continually filtered and returned to the crankcase, and as the bauxite elements become ineffective, they are replaced by new ones. As a result of that care, the bearings are supplied with clean lubricating oil at all times, thus insuring long bearing life with a minimum of attention.

The installation of the exhaust lines is unusual in that they had to be routed so as to clear the overhead crane and other equipment; they could not be directed straight up, as is customary. Consequently, they were run to the wall and then up to the roof, where Burgess mufflers are located. As these lines are insulated throughout and therefore hold heat they present a hazard in case of engine shutdown and leakage of fuel into the exhaust through the engine mixing valves. To overcome this hazard, positive shutoff valves are on the fuel-gas line to the engines. In the event of a shutdown, these valves automatically close and prevent any unburned fuel gas from reaching the exhaust lines. The fuel gas is brought into the plant at approximately 2 pounds pressure, and there a sensitive low-pressure regulator drops it to the equivalent of about 3 inches of water pressure before it enters the mixing valve and mixes with air in the proper proportion for use in the power cylinders. As with the electric units, all possible provisions in the way of safety valves, shutdown devices, etc., were made to protect the machinery and the personnel from unforeseen happenings.

The gas-engine and the electric units feed directly into a 12-inch main-line air header that extends completely around the building and from which laterals run to the plant's numerous working stations where compressed air is used to operate pneumatic equipment.



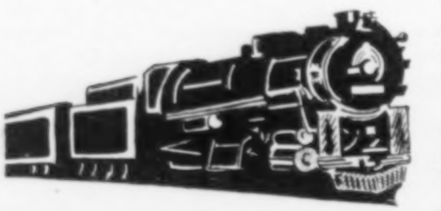
"My Day"

C. W. Gibbs

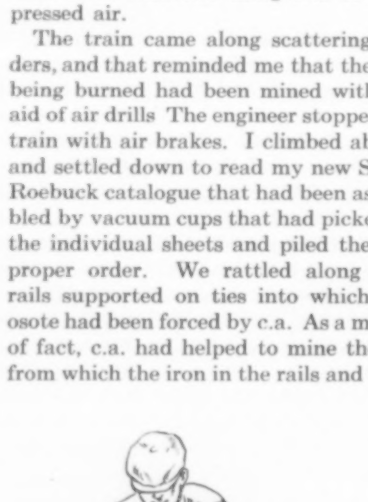
WE HAVE a new fire whistle in our New Jersey town, one of those compressed-air sirens. The 2-5 signal woke me early one morning; that meant the fire was near our home! I scrambled into my clothes and went out to see the excitement. The fire didn't amount to much, and the firemen extinquished it with a little water. I don't know what made me excercise my brain so early that day, but my thoughts ran like this: "The alarm was sounded by compressed air, the firemen rushed to the scene on air-filled tires, and the water they used was originally pumped from the ground by compressed air. I wonder how many more times compressed air will enter my life or cross my path today." To satisfy my curiosity, I kept a log, and here it is:

When I returned home, the storm door didn't slam because it had an air-cushioned "closer." After shaving with a razor blade that had been made with the assistance of c.a., I put on a shirt that had been pressed by c.a. power and went down to breakfast. I had toast made from grain that was unloaded pneumatically from cars at the flour mill. My coffee was extra good since it was vacuum packed, and isn't vacuum compressed air in reverse?

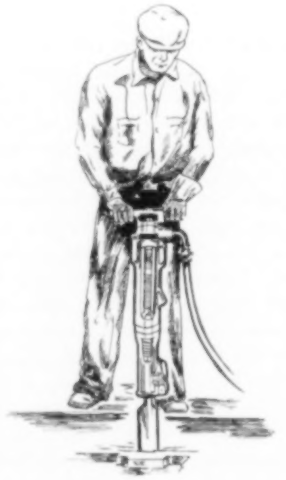
Filling my pipe with tobacco that also had been vacuum packed, I lit it and went out the door, which again didn't slam. After pumping up the girls' bicycle tires, I walked to the railroad station. I could have driven our car, which fortunately has tires that still hold air, but I walked by preference and also because my wife was planning to take it down later for a washing, greasing, and paint-touch-up job that would require c.a. The gas tank was to be filled with gasoline from refineries using lots of compressed air.



The train came along scattering cinders, and that reminded me that the coal being burned had been mined with the aid of air drills The engineer stopped the train with air brakes. I climbed aboard and settled down to read my new Sears-Roebuck catalogue that had been assembled by vacuum cups that had picked up the individual sheets and piled them in proper order. We rattled along over rails supported on ties into which creosote had been forced by c.a. As a matter of fact, c.a. had helped to mine the ore from which the iron in the rails and train had been made and had been used in tremendous quantities in smelting the iron ore in the blast furnace and in changing it into steel. Futhermore, the cars and engine had been assembled by riveting hammers and other pneumatic tools and been spray-painted by c.a.

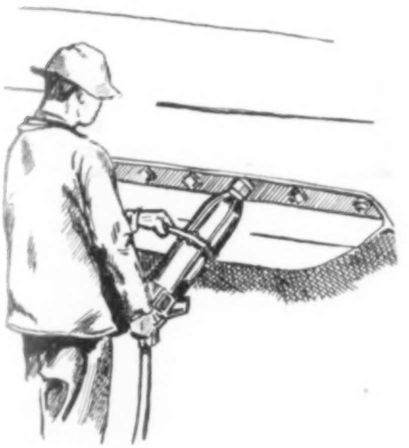


As we passed within sight of the Newark airport, one of our new mammoth transport planes was preparing to land. It had been built with air-driven tools and was fitted with shock absorbers charged with c.a. and with pneumatically controlled landing gear, rudders, etc. The tires were pneumatic, its radio had vacuum tubes, and the engines were supercharged with c.a. Then we passed railroad shops, where I knew air tools were repairing cars and engines and making many tough jobs easy.



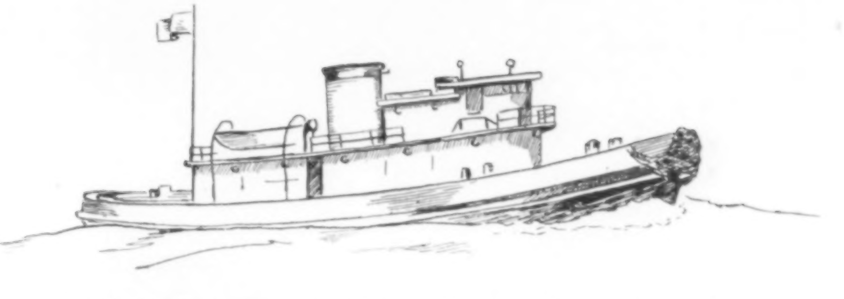
We crossed a bridge the piers of which stood on caissons sunk under air pressure. The steelwork had been riveted together with air hammers. From my window I could see a track gang laying new rails—bolting them up, driving the spikes, and tamping the ballast under the ties with air tools. In the station yard, we clattered over interlocking switches, all operated by c.a. The train drew to a stop—air brakes again—and I walked toward the ferryhouse. I stopped to visit the nearby yard powerhouse, where an automatic air-operated soot blower had been installed in a new boiler. It was working splendidly.

On the ferry my friend Rube confided that he was worried over his need for a new compressor. He said his production of some multisyllabic chemical was dependent on a steady supply of c.a. and that all his present machines were going full tilt to fill urgent war orders, permitting never an hour's shutdown for maintenance. We passed a new tug plugging along up the river. It happened to be a diesel-engined vessel with air-operated steering gear and with air clutches of a new type on its propeller drive. It can reverse in less than five seconds. The engines are started by c.a., too. Just then the captain of the towboat blew the air whistle, and I jumped so quickly that my hat was swept off in the breeze and nearly went into the river. Air in motion is all right in its place, but I didn't like it to get so personal with my hat. In a dock near the terminal slip on the New York shore was a sea-worn ship from which the rattle of pneumatic scaling hammers could be heard as the crew cleaned her sides for repainting.



During the walk to the office I paused beside a building excavation. Rock drills were working away in one corner of it to clear the final foundation rock while in another corner, where the ground was "filled," an air-driven pile driver was sinking sheathing to keep the "goo" where it belonged. Later, the steelwork would be put up amid the clatter of air-operated riveting hammers. It was a dark day, and as I switched on the lights (bulbs blown with c.a.) electricity flowed through wires made from copper mined far underground with c.a. and lifted to the surface with immense c.a. hoists.

About ten o'clock a customer came in from Long Island, where water is obtained from air-lift wells, and we started uptown to visit a sewage-disposal plant. The subway motorman overran a red light, and the safety stop threw the air brakes on with a slam. No one got hurt, but we slid around a bit. My customer was interested in the large blowers that were used to provide agitating air for the activated-sludge tanks. This is a beautiful plant and was not unpleasant to visit—strange as that may seem. I left him at the Pennsylvania Station after lunch and saw him go through the magic doors that open as one approaches them. It is not done with mirrors, or by black art—the doors are swished open and shut by c.a. cylinders controlled by "electric eyes." Then I stopped in a department store to make a purchase and rode to the proper floor in an elevator, the doors of which were air-operated.



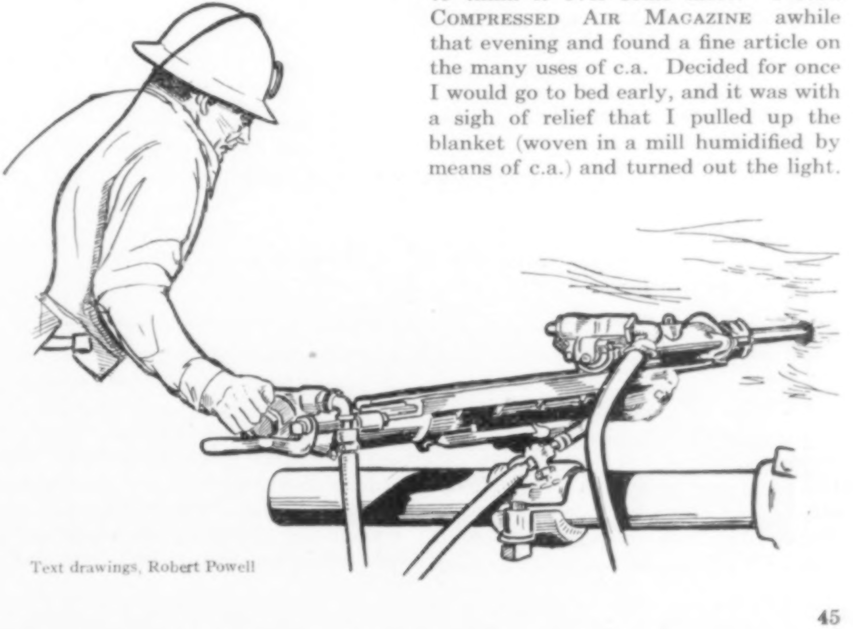
Again approaching the office, I found that during the day workmen had been digging up the street surface with c.a. tools and were laying new asphalt which had been agitated or "blown" with c.a. to get it to the proper consistency, etc., before mixing with stone. I mentally noted also that the concrete sidewalks were made with cement which had been quarried, agitated during some stages of manufacture, and loaded into and possibly out of railroad cars with c.a.

On my desk were several letters, most of which had been shot from the main post office to our local branch through a pneumatic tube. A man in the West asked where he could buy equipment to line a tunnel with concrete. I referred him to two firms, each of which sponsors a method using c.a. About three o'clock a phone call summoned me to the other side of the building that overlooks the Hudson. The *Normandie* was going down the river. That was a real sight! She looked like an aircraft carrier. Watching her, I thought "Without c.a. for divers, tools, etc., that ship could never have been raised."

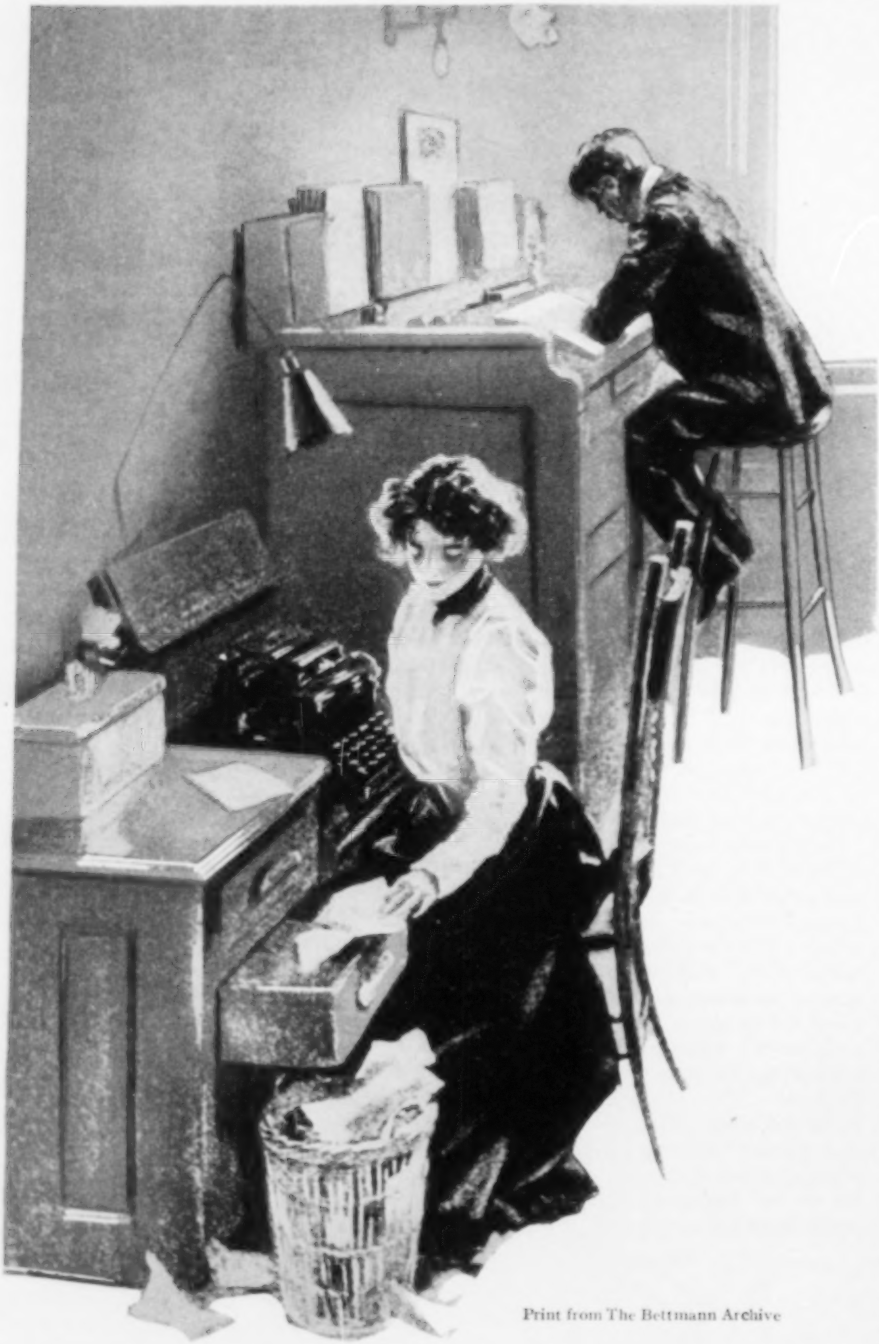
I had to leave early to keep an engagement at the dentist's. He did a lot of work, then sprayed my mouth with his c.a. atomizer and offered me a drink from a paper drinking cup, the kind made with the aid of c.a. I also stopped at the furrier's for my wife's fur coat which had been through a cleaning process that uses c.a. On the way home the train took the long way around (on account of bridge trouble on the regular route) and we passed a shipyard. Many riveting hammers, drills, reamers, impact wrenches, chippers, etc., were busy there building destroyers and transports.

At home I found my good wife preparing the evening meal on our shiny enameled gas stove. The metal in that stove had been pickled in an acid bath agitated with c.a., then it had been shotblasted, and finally the enamel had been sprayed on with c.a. As for the gas, c.a. played a part in some of its manufacturing processes, as well as in the maintenance of the equipment. After dinner, eaten with silverware stamped or coined by pneumatic hammers, I fired the furnace, which had been cast in a sand mold tamped with c.a. tools.

Later on a man called to try to interest me in insulating the house. I asked him how he got the insulation into the spaces between the walls, and he replied, "Oh, we blow it in with c.a.; use c.a. in making it, too." The proposition sounded good, but I wanted to think it over some more. I read Compressed Air Magazine awhile that evening and found a fine article on the many uses of c.a. Decided for once I would go to bed early, and it was with a sigh of relief that I pulled up the blanket (woven in a mill humidified by means of c.a.) and turned out the light.



Text drawings, Robert Powell



Print from The Bettmann Archive

"GAY-NINETIES" OFFICE

Typewriters were used to some extent, but carbon paper was a new-fangled thing, and copies were generally made on tissue paper in a letter press. Desks served also as filing cabinets, which accounted for their highboy appearance. Clerks were perched uncomfortably on elevated stools without backs. Modern desks brought them down to earth.

Carbon Paper

Donald S. Sharpe*

"NECESSITY is the mother of invention," to quote a familiar saying, and it was unquestionably need that caused someone to conceive the idea of manifolding with carbon paper and thus greatly improve upon the old counting-house method of duplicating. In those days business moved slowly and with dignified simplicity. The head of a house, elegantly turned out in a topper and cutaway, was driven to his office in a smart coach at no more than a spanking trot. The humble bookkeeper in his steel-framed spectacles and "alpaca" slowly and meticulously wrote out each page in his best Spencerian hand. Style and exactness were the keynotes in recording, and many a gnarled-handed clerk toiled until the wee small hours to produce the necessary copies of letters and papers that found a resting place perhaps in a roll-top desk or a 3-masted schooner outbound for the Indies.

In time, as the nation developed and business detail grew more and more complex, it became evident that "pushing a pen" and other slow and laborious office procedure were no longer adequate. It was then that carbon paper came into being. At first, it was nothing "to write home about" because of a lack of chemical knowledge and the absence of chilling machinery to set the coating on the paper. The film of carbon was little better than lampblack mixed with grease and beeswax. Furthermore, the art of making white carbonizing paper was in its infancy; the product that came from the mills during the early experimental days was full of flaws and varied in weight and porosity. Hardening chemicals such as are used today were then an unknown quantity, and it was only natural that this paper, when carbonized, not only smudged the hands but also turned out smeary and generally untidy work.

In the years that have intervened, all the deficiencies have been gradually overcome, and today manufacturers of high-grade carbon paper carry in stock some ten or twelve different weights ranging from a 4-pound featherweight tissue for maximum manifolding to a 20-pound, long-wearing pencil carbon for rough single copies. It is available in six colors—black, purple, green, blue, red, and brown—and in seven degrees of inking, varying from the extra-extra manifold coating for noiseless typewriters to the extra-extra hard for single-copy work where a sharp, gray "write" and wear are paramount factors.

If carbon coatings could be sprayed on like Duco paint and dried well-nigh instantaneously upon exposure to air, carbon-paper making would be a relatively easy job. Instead, the mixture is of the consistency of fudge, and calls for the finest hard waxes which, together with the pigment specified, must be ground for hours. Special oils are added in the course of the grinding, and heat is applied to reduce the ingredients to a free-flowing mass that will coat evenly, penetrate the paper, and remain flexible. Chemical compounds also are added, the quantity depending upon the degree of surface hardness desired. The finished coating must not contain the slightest trace of grit—must be as smooth as glass.

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*Waters & Waters Division, Neidich Process Company

Application of the mixture is effected by a series of rollers over which the paper tissue moves in an endless strip. The process is a continuous one, and immediately after the paper is coated it passes between precision leveling or graduating knives that insure even distribution of the mixture. Next the paper travels over a series of cooling rollers that vary progressively from room temperature to a degree of chill sufficient to harden or "set" the coating. Upon leaving the chilling rolls, the carbonized tissue is free from tackiness or stickiness and is ready to be cut into standard box sizes of 8½x11, 8½x13, and 8½x14 inches, or into regular ream sizes ranging from 17x22 to 26x39 inches.

It all sounds very simple; but it isn't. If the chilling rollers are not cold enough, then hundreds of thousands of sheets turn out to be too soft. By the same token, if they should be too cold, the mixture sets too soon—becomes brittle before penetrating the paper. This causes the coating to slough or crack off in large pieces when the paper is put to use. In short, the whole procedure may be likened to preparing a soufflé. If the ingredients are properly prepared, the temperature is of the right degree, and the timing is faultless, the finished product is perfect; but if something is the slightest bit off, the whole thing falls flat. It might be added here that it is a wonder nowadays that carbon paper is as good as it is. Under present wartime conditions the basic ingredients inevitably vary, and no two lots of tissue paper are the same. Besides, selective service takes experienced workers faster than they can be trained.

When it comes to the use of carbon paper, it should be chosen with care, for each weight is made with a specific service in mind. This is not always taken into account, and, more often than otherwise, the paper is blamed if it does not do what it is supposed to do. There are a number of things to be considered in selecting a sheet of carbon for a given job. First, there is the matter of weight, which is determined by the number of copies to be made at one writing and by the type of machine used. If it is a regular typewriter, the requirements are:

Standard weight or 7-pound, 1 to 4 copies
Medium weight or 5½-pound, 5 to 8 copies
Lightweight or 4-pound, more than 8 copies

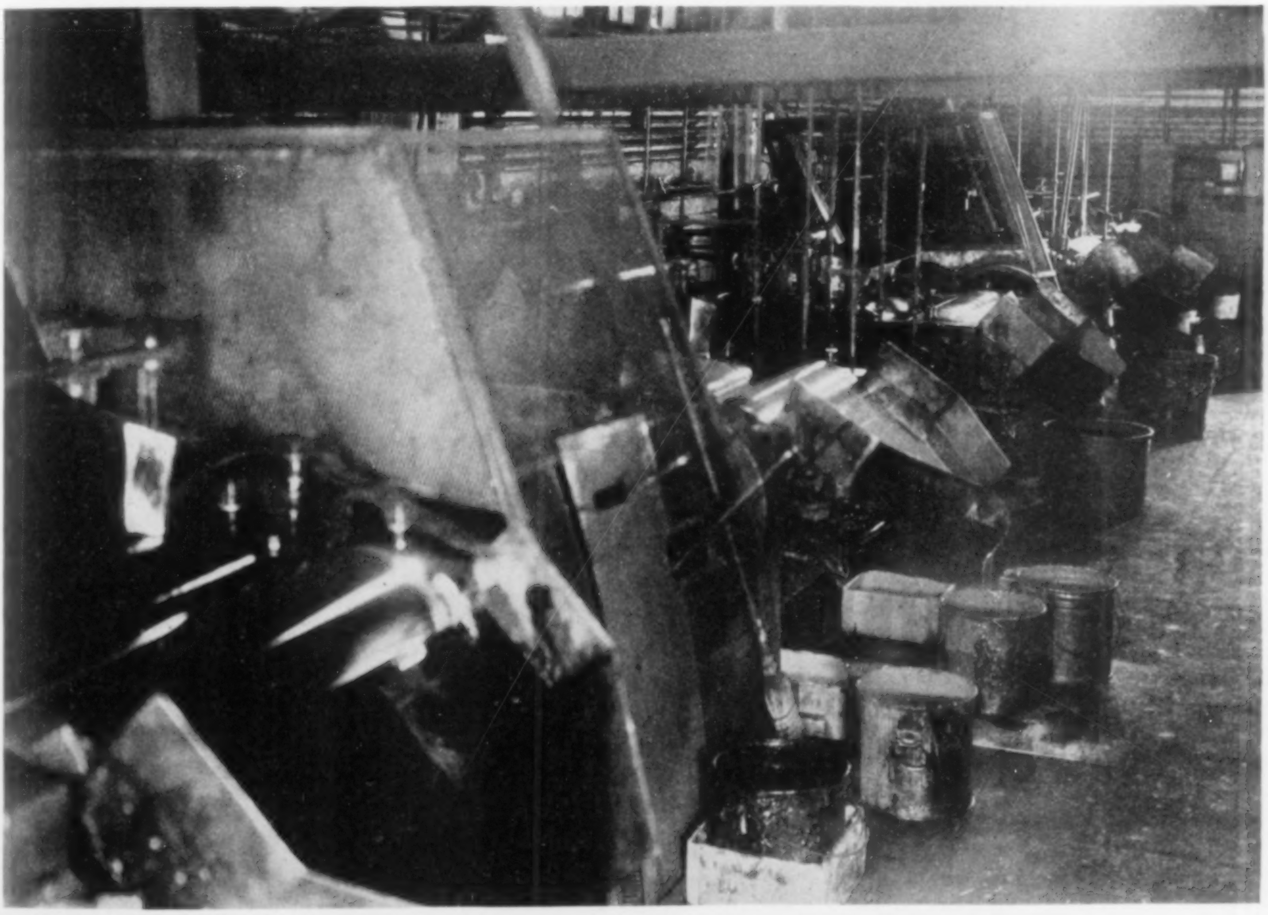
In the case of a noiseless machine:

Standard weight or 7-pound, 1 to 3 copies
Medium weight or 5½-pound, 3 to 6 copies
Lightweight or 4-pound, 6 to 10 copies

For a billing or bookkeeping machine:

15-pound, 1 to 2 copies
12-pound, 3 to 4 copies
10-pound, 5 to 6 copies
8-pound, more than 6 copies

Carbon paper, like lead pencils, comes in varying degrees of hardness. Some prefer a soft sheet because it leaves a dark imprint and is suitable for heavy manifolding work. Others prefer one with a hard finish because it is cleaner to handle and the impression, though fainter, is sharp and smears less under erasure. If of proper quality, the latter also lasts longer because the amount of coating knocked off with each type impact is measurably less. Hard, medium, and soft formulas are recommended for



GRINDING INK

The grit-free carbon coating for paper is the result of hours of grinding of a mixture of pigment, wax, oils, and certain chemicals that impart to the finished coating the desired degree of hardness.

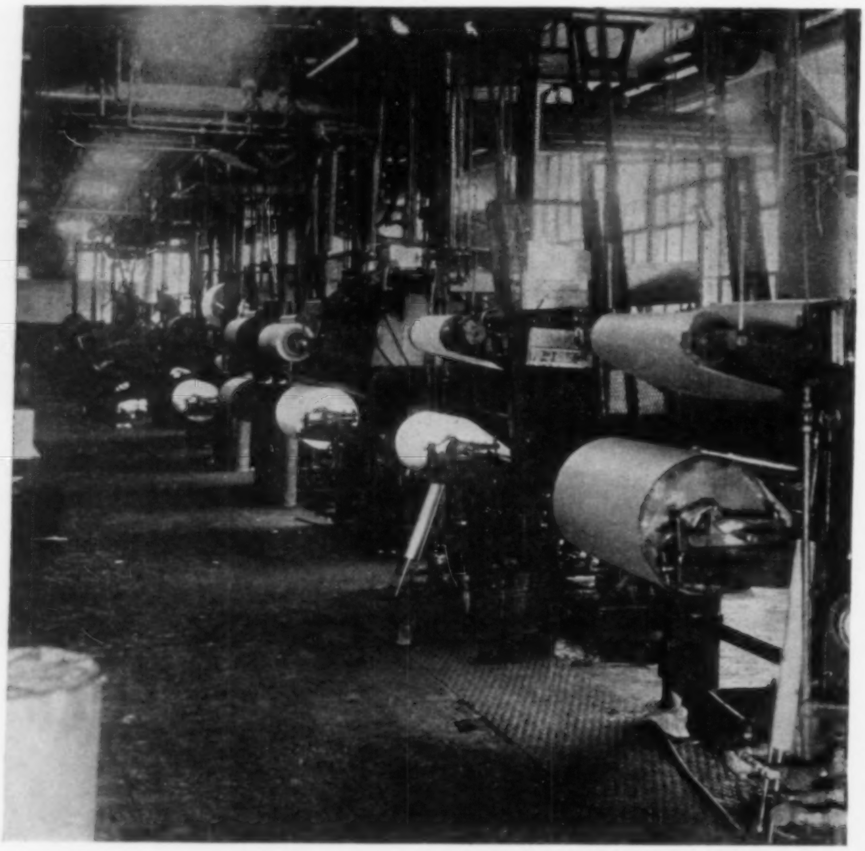
general office and correspondence work, while extra manifold and extra-extra manifold are best adapted for making many copies and where a jet-black write is desired. These soft carbons are especially suitable for noiseless typewriters and for operators with a light touch. For financial reports and statements that are frequently handled, or where exceptionally clean gray copies are required, there are the extra hard and the extra-extra-hard carbons.

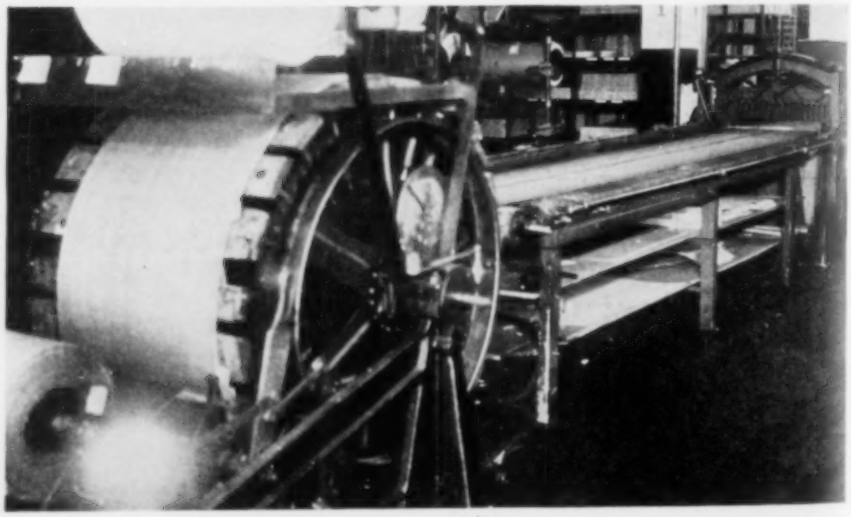
The results vary, of course, with the kind of machine used, the condition and hardness of the platen, the type, and the operator's touch. Cleanliness is a vital factor. If the type is filled with lint and ink, or if it is sprung, a clear, legible impression cannot be obtained. Thickness, quality, and finish of the copy paper also have a bearing, as well as the thinness and quality of the ribbon. If the typewriter is old and the platen hard and corrugated, a hard-finish carbon paper will give the most satisfactory service. Soft platens need a blacker-writing sheet, as there is nothing substantial for the keys to strike against.

The most popular sizes of type are pica, elite, and billing, with pica in the lead. A good rule to follow is to use a standard-weight, medium-finish carbon with the billing type; a relatively thin, hard-finish paper with the elite; and with the pica a sheet that the particular manifolding requirement dictates. Stenographers who merely tap the keys should be provided with a manifold carbon with a soft or noiseless-machine finish. Others, who pound out their work, will get best results with a hard-finish sheet. Treeing—that is, wrinkling, is the direct outcome of improper feed. Careful insertion of the copy papers and carbons, together with release of excess tension on the feed-roller clips, will largely obviate this trouble. As to the copy paper, it is advisable to use 9- to 11-pound paper for ten copies and extra-thin white tissue for more than that. Failure to do this will lead to unsatisfactory work.

Conservatively speaking, the type in about 75 per cent of the country's typewriters is partly or wholly filled with a combination of dust, lint, and ink. When the type face is sharp-edged, clean, and in perfect alignment, it makes a clear-cut impression. However, it is a human frailty to dislike a dirty, messy job, and many a typed "o" resembles a tiny black ball only because of an aversion to getting out a stiff brush and liquid cleaner and getting busy. Invariably the fault is laid at the door of the carbon paper or the typewriter ribbon, when the operator is really to blame.

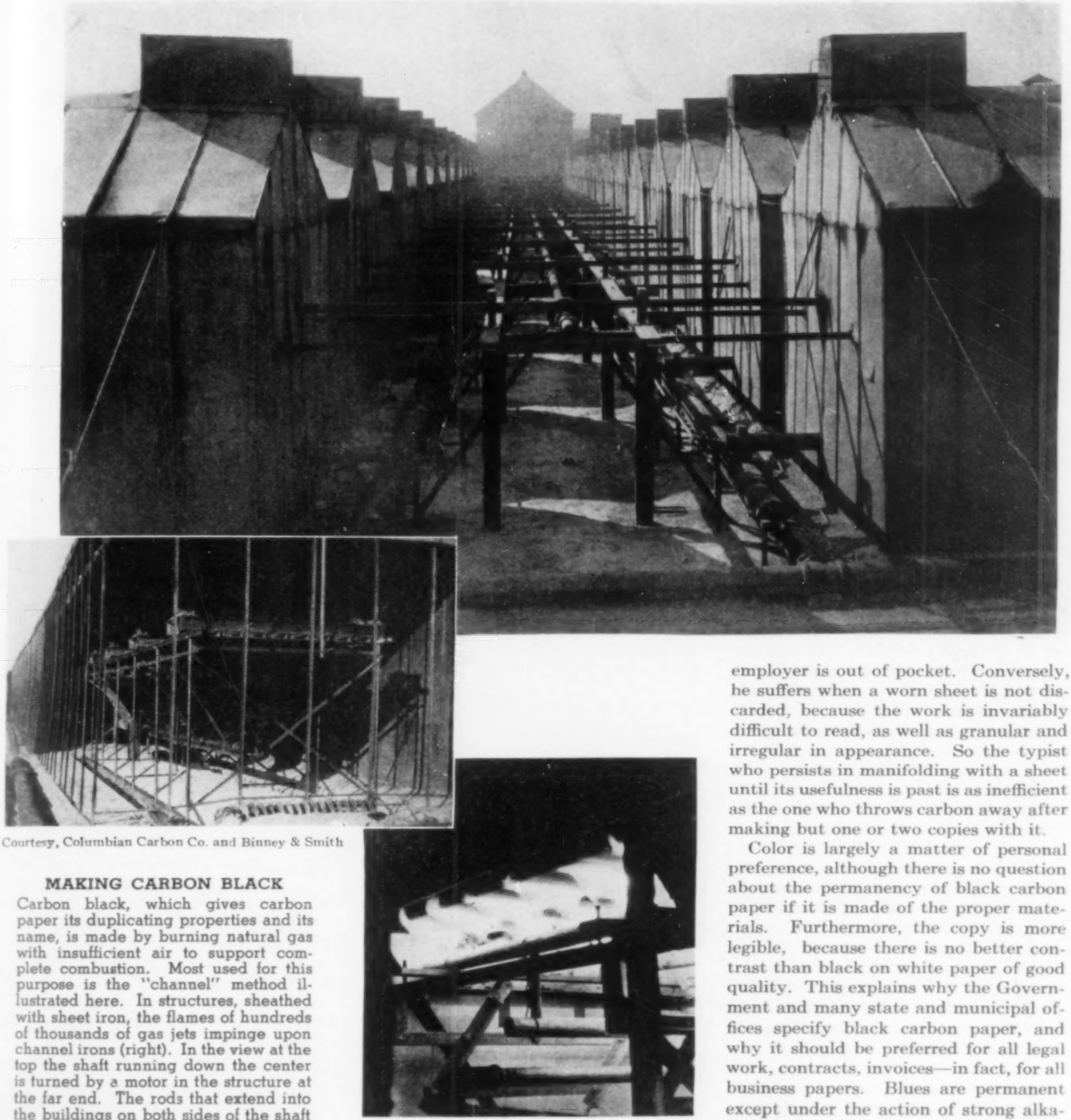
Carbon paper, having a wax base, reacts instantly to heat and cold. Heat, as well as moisture, causes the tissue to curl outward by reason of expansion, whereas cold causes it to curl inward through contraction of the wax. It is therefore important that carbon be kept in a place where the temperature is uniformly around 70°F. To show just what can happen when carbon paper is not properly stored, let us cite the case of a





COATING AND CUTTING

High-grade tissue paper made from flax, and somewhat similar to cigarette paper, is fed from rolls to coating machines, as shown above. Accuracy of control produces papers graded for different degrees of "write" and sharpness. After being coated, the paper is cut into ream sizes (right) and stored for seasoning.



Courtesy, Columbian Carbon Co. and Binney & Smith

MAKING CARBON BLACK

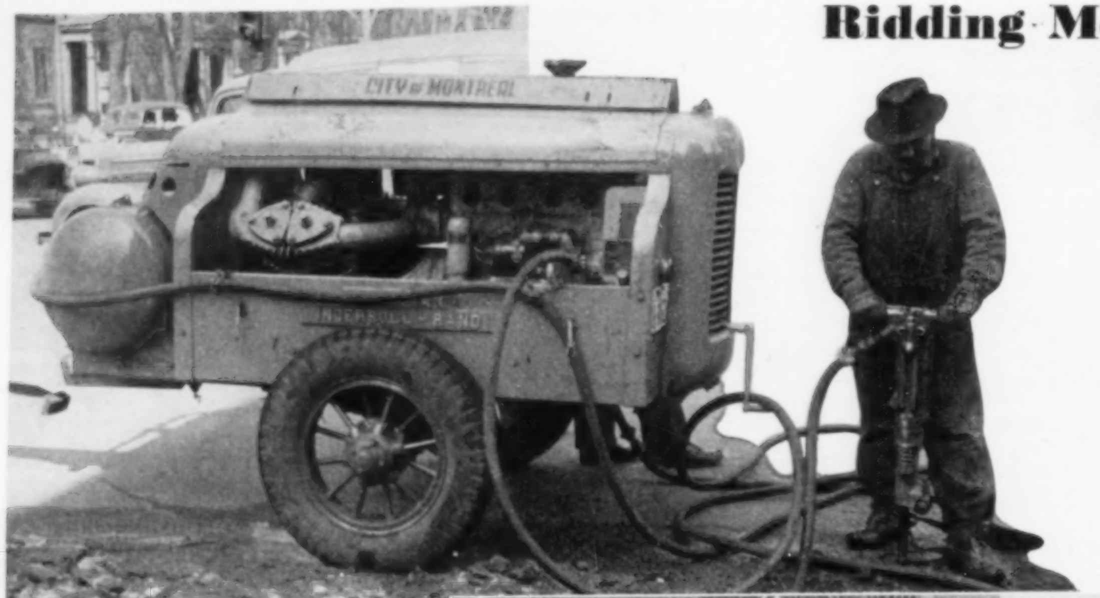
Carbon black, which gives carbon paper its duplicating properties and its name, is made by burning natural gas with insufficient air to support complete combustion. Most used for this purpose is the "channel" method illustrated here. In structures, sheathed with sheet iron, the flames of hundreds of thousands of gas jets impinge upon channel irons (right). In the view at the top the shaft running down the center is turned by a motor in the structure at the far end. The rods that extend into the buildings on both sides of the shaft are connected to the latter by gears and cams and move the channels back and forth, causing scrapers to remove the films of carbon that form on them continually The carbon falls into hoppers, shown directly above, from which it is transferred by screw conveyors to two main conveyors between the rows of structures and delivered to the motor building, which is also a packing house. According to the 1940 "Minerals Yearbook," there are about 50 carbon-black plants in the United States, mostly in Texas. The 1940 production was 568,000,000 pounds, and the average yield per 1000 cubic feet of gas burned was 1.54 pounds. Nearly 90 per cent of our carbon black goes into automotive tires. One of our war uses of this material is to reduce glare on airport runways.

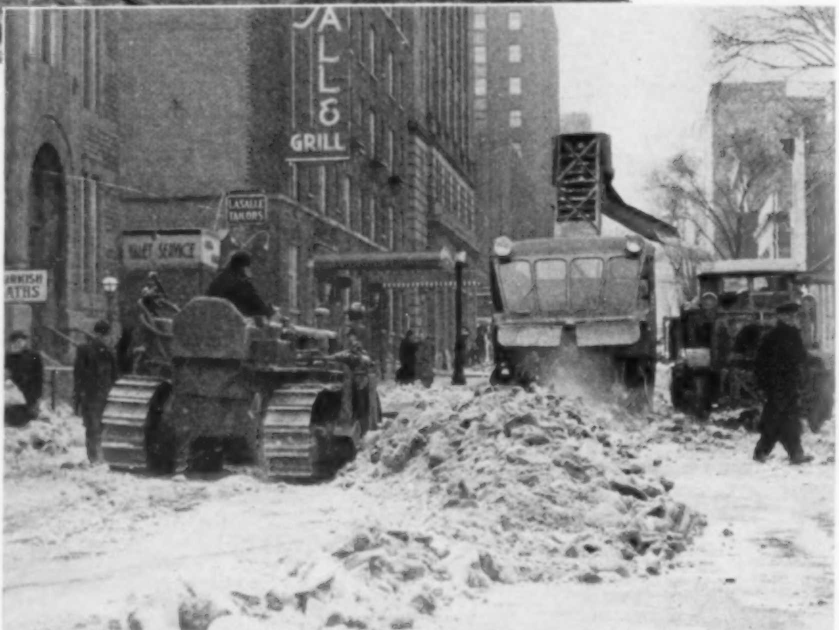
large concern in the Middle West that stacked 2000 boxes of 5½-pound tissue on metal shelves not more than a foot from a row of heating pipes that were not insulated. It was not long before the manufacturer received a long-distance telephone call complaining that the carbon was stuck together. Upon investigation it was found that the shelving was not only uncomfortably hot to the touch but that the temperature at some points was as high as 140°! Naturally, the coating melted, with the aforementioned result.

Carbon should be used until it ceases to record legibly. If that is not done the employer is out of pocket. Conversely, he suffers when a worn sheet is not discarded, because the work is invariably difficult to read, as well as granular and irregular in appearance. So the typist who persists in manifolding with a sheet until its usefulness is past is as inefficient as the one who throws carbon away after making but one or two copies with it.

Color is largely a matter of personal preference, although there is no question about the permanency of black carbon paper if it is made of the proper materials. Furthermore, the copy is more legible, because there is no better contrast than black on white paper of good quality. This explains why the Government and many state and municipal offices specify black carbon paper, and why it should be preferred for all legal work, contracts, invoices—in fact, for all business papers. Blues are permanent except under the action of strong alkalies. Purple is affected by light, and even the best carbon of that color has a tendency to fade in time. Green, red, and brown are made of the strongest aniline dyes produced and, exclusive of brown, can be considered permanent under the usual filing conditions. They, too, however, are somewhat affected by light. Some buyers insist that a color or a strength of write be matched exactly. This is not always possible because paper, wax, dyes, operating conditions, etc., vary. Legibility is of far more importance, and the thing to do is to study the requirements of an office and then get the paper that will give clear, readable impressions and reasonable wear.

Ridding Montreal Streets of Ice





SPRING CLEAN-UP

Ice that is too thick and compacted to be removed by ordinary methods is easily broken up by pneumatic paving breakers supplied with air by a portable compressor, as illustrated at the top. The machine is driven by a gasoline engine and operates two CC45 paving breakers, only one of which is seen. Directly above is a winter scene in downtown Montreal showing the other equipment that is used to clear the streets for traffic. At the left a bulldozer is piling up chunks of ice for the loader immediately behind it. The latter breaks up the pieces and dumps the material into the truck alongside.

JACK FROST is no stranger to the citizens of Montreal, and his icy fingers raise considerable havoc there before spring thaws chase him into hiding. His pranks take shape in swirling snows, hard-packed ice, and ear-nipping subzero temperatures. These annual caprices are always troublesome and expensive to the Department of Public Works. Montreal, with a population of about 1,000,000, is said to face the most difficult snow-removal problem of any municipality in North America. Complicating matters is the fact that the downtown section is the oldest in the city and is crisscrossed by many narrow streets. Naturally, it is in this congested business area that rapid snow-clearing is most in demand.

For more than fourteen years Montreal has used mechanized methods in coping with this situation. However, it was not until 1939 that the purchase of specialized apparatus was begun on a large scale. At that time $471,000 worth of equipment was acquired, and the results obtained with it in the winter of 1939-40 were so satisfactory that more machinery has been added year by year. The department is now well provided with snow blowers, automotive loaders, street flushers, trucks, plows, tractors, trailers, portable air compressors, and paving breakers.

At first thought, the last two items may seem to be peculiar. Actually, the buying of compressors and air-operated paving breakers was dictated by necessity. Where temperatures drop from 40°F. in the afternoon sun to 40° below zero in the early morning hours there is bound to be ice, layers and layers of it. In some places the streets have been known to be covered with it to a depth of 3 feet. Obviously, any attempt to remove such thick formations by conventional mechanical equipment would impose a severe strain upon them. In addition, the work would be slow and costly. The alternative was a type of machine that could penetrate ice from the top and break it into chunks. The answer was air-operated paving breakers and portable compressors to supply the power for these hand-held tools. Inasmuch as the compressors are mounted on wheels, they can be hauled from place to place without loss of time, a factor that is of great value in combating the traffic difficulties arising from severe winter weather.

Montreal officials report that their method of ice-breaking has proved to be successful and has evoked interest in other northern communities where similar conditions are encountered. The procedure is simple, direct, and economical; and the heavy-duty paving busters have shown that the job of ice removal need not be a formidable one.

EDITORIAL

No Power Shortage

IN JULY of 1942, we wrote here that the volume of electrical energy to be produced in the months to come would have a vital bearing on military success abroad and commented on the encouraging fact that there seemed to be ample generating capacity to meet the needs of our steadily expanding manufacturing program. It is gratifying to note now, eighteen months later, that this prediction has come true, and to pay a tribute to the foresightedness of the management of the public-utility industry.

During the year ended last July there was generated in the United States approximately 203,000,000,000 kw-hrs. of current, an amount that probably comes close to the combined output of Germany, Japan, and the countries dominated by them. Additional generators have since been put in operation in this country. During the past two years we have been deficient in many things, but there has been no serious power shortage. The only case of rationing of electricity was recorded in an area that is served by a governmental power agency and where private companies immediately sent in current over interconnecting lines to make up the temporary deficiency that was caused by low water in streams feeding hydroelectric plants.

The average household has not had to curtail its use of electricity one bit. When dimout regulations were recently lifted along the eastern seaboard, the gay white ways of the cities in the area resumed their former nightly brilliance at the turn of switches. The extra load put no strain on generating plants or on distribution networks despite the great increase in industrial-power consumption since the war began.

Ninety per cent of our electrical energy comes from privately owned utilities. Without fanfare or trumpeting, they have met every demand made upon them. Moreover, in the face of rising costs, they have continued to lower rates, thereby maintaining a 30-year trend. They could do all this because they had built for the future well in advance of its coming.

Hp.

HORSEPOWER is a measure of the rate of doing work. The term was originated by Boulton and Watt to express the output of their steam engine. Watt is said to have ascertained by tests that the average cart horse could exert a pull equal to 22,000 foot-pounds of work per minute. Being an honest manufacturer, he made sure that his customers would get full value by increasing that figure by one-half and rating his engines accordingly. The standard he arrived at—33,000 foot-pounds per minute—has since been accepted as the horsepower unit.

We are so accustomed to applying this term to machinery that there is a tendency to forget that it has an animate concept. Farmers haven't forgotten it, though, because horses have been doing an increasing amount of their work during the war. To quote the Horse and Mule Association of America, Inc., "Much credit for two of the largest crops ever raised in the United States must go to horses and mules—over 12,000,000 of them—that were in harness in 1942 and 1943 producing farm crops. Never in all history have horses and mules done so much in so short a time; never before has so large a proportion of all horses and mules in existence been at work." The 25,000 tons of steel annually required to make harnesses, collars, saddles, horseshoes, and horseshoe nails for these animals is less than that needed to build 20,000 tractors.

In view of the foregoing facts, it is not surprising to learn that the prices of draft animals are higher than normally. Mules bring from $165 to $250 each in the Central West, more in the Southeast. Work horses weighing 1,300 pounds or more sell for from $125 to $185 a head. Even higher figures are predicted for the coming spring.

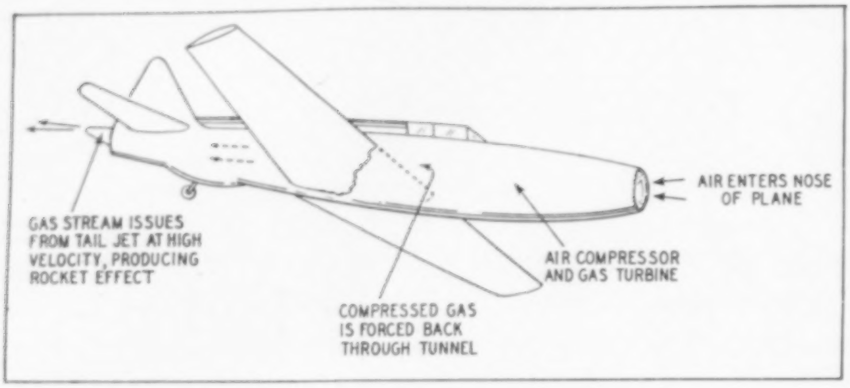
Edison Anniversary

THIS month marks the ninety-seventh anniversary of the birth of Thomas A. Edison, whose name will live as long as the world endures. His inquiring mind paved the way for many of the comforts and luxuries we now enjoy, and even for some such as electronic developments and television that are yet to come. For more than 50 of his 84 years Edison was inventing things, and more than 1,000 patents stand to his credit. He attended school only three months, began to earn his living at twelve, and was a telegrapher at fifteen. His first patent was issued the year he was eligible to vote and, appropriately, covered an electric vote recorder. Most of his conceptions related to the phenomena of electricity and magnetism, but they led him into many fields. For example, for a period of about nine years he spent most of his time working on a magnetic process for concentrating magnetite ores.

Edison was a man of peace, and most of his research was aimed at making the world a better place in which to live. Nevertheless, numerous of his discoveries are serving the nation well in the present war. In 1883 he patented what became known as the "Edison effect"—the passage of electrical current from a filament to a plate of metal inside a lamp globe. This was the forerunner of the radio tube and of the myriads of electronic tubes that are vitally important in our wartime communications and protective systems.

Edison always looked ahead, envisioning better things, and all his thinking and planning were directed toward that end. He founded important industrial concerns that are carrying on today under his name, devoting their entire efforts to making war materials. To those who worked with him and for him in these establishments he left the following simple message that was typical of his foresightedness: "I trust you for progress."

Compressed Air May Drive New Jet Plane


GAS STREAM ISSUES FROM TAIL JET AT HIGH VELOCITY, PRODUCING ROCKET EFFECT
COMPRESSED GAS IS FORCED BACK THROUGH TUNNEL
AIR COMPRESSOR AND GAS TURBINE
AIR ENTERS NOSE OF PLANE

ITALIAN JET-PROPELLED PLANE
Simplified working diagram of the Caproni-Campini plane that was designed by Secondo Campini for the Italian air force and was reputedly flown successfully in 1940-41. Jane's publication, "All the World's Aircraft," credits the machine with a flight of 168 miles from Milan to Rome on December 1, 1941. Air taken in at the front is compressed in a rotary blower, mixed with fuel for burning in a gas turbine, and the hot, expanding gases from the latter provide the thrust that pushes the plane forward. The illustration is based upon one that appeared in "The Aeroplane," a British trade publication.

THE new jet-propelled fighter plane that has been developed by Great Britain and the United States probably depends, in part at least, upon compressed air for its operation. A jet-type plane of Italian origin that was previously announced combines a compressor and gas turbine, and it is assumed that the new Allied ship operates upon the same principle. In the Italian model, air taken in at the front is compressed in a blower, and then some, or perhaps all the air is mixed with fuel, which is burned in a turbine. The power developed is used to drive the blower. The hot expanding gases issuing from the turbine, together with surplus air from the blower, are expelled through a jet or jets at the rear of the fuselage, producing a rocket-like effect.

At this writing, details of the power plant of the new Allied plane and of the manner in which the craft is thrust forward have not been made public. However, London suburban residents saw and heard one of the new planes streaking through the air and whistling like a giant teakettle early in January. On the following day, Gen. H. H. Arnold, commander of the American Air Forces, announced that the propellerless craft had satisfactorily completed months of test flying both here and abroad and that it would soon be in regular production.

The Allied version of the jet or rocket plane is now disclosed as the brain child of Capt. Frank Whittle of Britain's R.A.F. He took out a patent in 1930, but was unable to interest commercial builders in his idea. He interrupted an army career from 1933 to 1937 to attend Cambridge University, and four friends he made there raised money and founded a company known as "Power Jets" to carry on the developmental work he had started. His first engine ran successfully in 1937, and the initial flight was made in May, 1941. Since then a number of engines have been constructed in England and the United States.

The engine used on the first flight was brought to America in July, 1941, and turned over to the General Electric Company to serve as a model. Six months later, modified versions of the original power plant were being turned out. The Bell Aircraft Corporation was commissioned to build a plane suitable for the new engine, and on October 1, 1942, the first flight was made in this country.

Air speeds of 500 to 600 miles an hour are claimed for the jet plane. These are well above the best performance of the propeller-type plane. It is also claimed that the new craft fly better than the current models in the rarefied atmosphere of higher altitudes. For the present, jet propulsion will probably be applied only to fighter planes. Meanwhile, research is underway looking toward extending its application to bombers.

Service-Station Compressors Standardized

ACCORDING to a recent announcement by the Division of Simplified Practice of the National Bureau of Standards, industry has approved a simplified practice recommendation for air compressors of ½ to 10 hp. for service stations and garages. The recommendation covers motor-driven, automatic-start-and-stop compressors of air-cooled construction that are mounted on horizontal receivers and have a pressure range of from more than 100 pounds to and including 200 pounds per square inch.

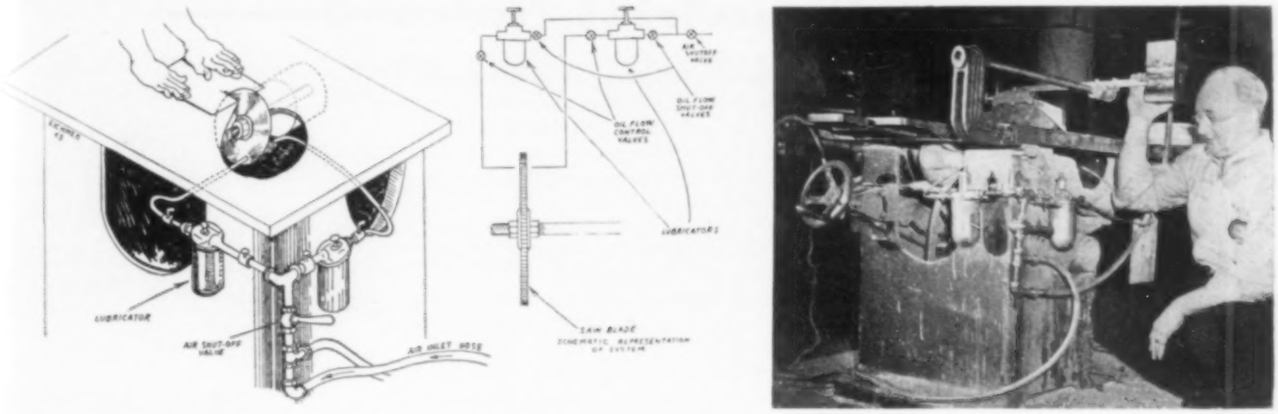
In consequence of this simplification program, 335 models have been eliminated. This reduction of 347 machines to 12 should bring about considerable savings of critical metals needed in the manufacture of equipment for our armed forces and enable the industry to obtain the benefits resulting from the production, distribution, and use of a simplified line. The schedule, like all others of a voluntary nature, is subject to revision from time to time when changing conditions warrant it, and does not preclude the building of special units when it can be proved that they are essential to the war program.

Pending printing, mimeographed copies of Simplification Practice Recommendation R202-43 can be procured from the Division of Simplified Practice, National Bureau of Standards, Washington 25, D.C.

The Useful Peanut

TO the 180-odd nonedible uses attributed to the peanut, the South's fifth largest crop, are being added still others that are filling a need today. The newest applications involve only the hulls which, with the exception of a small tonnage sold for fuel or feed, have had no market. Now there is a demand for them for the making of a substitute "cork" consisting of a mixture of 20 to 40 per cent peanut-hull fibers, meal, and a liquid binder. The product is said to be suitable for use as bottle-cap liners, inner soles, gaskets, wallboard, etc. It is the invention of Herman M. Kulman, and is to be manufactured by the Holfast Rubber Company.

Another field of service for peanut hulls is that of cleaning greasy machines and parts. For this purpose they are ground, together with corncobs, rice hulls, and similar agricultural waste, to a size that will pass through a 16-mesh screen. This granular material is applied by means of an ordinary sandblast gun equipped with a $\frac{3}{16}$-inch nozzle and removes grease, oil, carbon, and dust from valves, bearings, pumps, etc., without appreciable surface wear. Credit for the idea is due to the Northern Regional Research Laboratory, Peoria, Ill., of the U. S. Department of Agriculture working in coöperation with the armed forces.



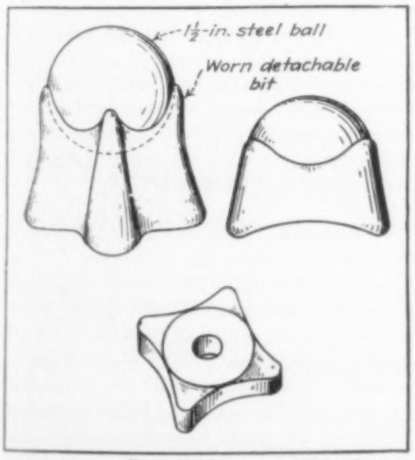
OIL SPRAY FOR CIRCULAR SAW BLADES

Installation and schematic views of an ingenious automatic oiling system for small circular saws that has come out of the suggestion box in the plant of the Murray Corporation of America. It was conceived by Emile Grafe, and is a big improvement over the old method by which the blade was lubricated with stick tallow rubbed on by hand. As the drawing in the inset shows, there are two lubricators, one for each face of the circular blade. The lubricant is castor oil, which is atomized and applied with compressed air. The flow of the oil can be controlled to meet requirements. The system has been in operation for some time and is said to have reduced saw replacements by two-thirds, cut down the amount of burring required, and contributed materially to safety of operations. The top of the worktable in the diagram is unobstructed to show the blade and the opposing sprays.

Worn Detachable Bits Do Useful Work

DETACHABLE bits, that have been resharpened again and again until they are worn down too much to be of further use for rock drilling, are no longer thrown into the discard. Instead they are serving as a substitute for steel balls in regrind mills. In the case of the Gem Concentrator of the Hecla Mining Company, for example, they are actually effecting a saving of $500 a month, according to W. L. Zeigler, the mill superintendent. Normally, grinding is done with 1½-inch steel balls. Now the mills are charged with balls and worn bits in the proportion of 70 to 30. The monthly charge of bits per mill is approximately 4 tons.

An interesting phenomenon is the way in which the individual balls force themselves into the open end of the bits after a brief period of service, forming a unit that is worn down progressively in the process of grinding until all that remains is a flat piece with slightly concave sides. As a result of this continual change in shape there is more frequent contact between the units than is the case when balls alone are utilized, and this has tended materially to improve grinding, in addition to effecting savings in both steel and operating costs. Another lead-zinc-silver producer, Bunker Hill & Sullivan Mining &Concentrating Company, is putting worn Jackbits to the same use.



From Engineering & Mining Journal

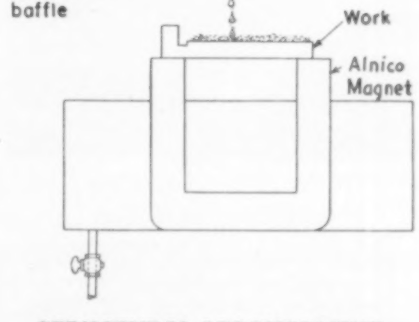
CHANGING SHAPE

This drawing shows how the steel balls and detachable bits combine in the grinding mill and progressively undergo a change in form until only flat pieces with concave sides are left.

Bubble Bath for Iron Filings

CRACKS and otherwise undetectable flaws in magnetic materials are revealed by placing the piece in a magnetic field, spreading a magnetic powder over the surface, and noting if the particles concentrate in and reveal the cracks as a result of the magnetic poles set up by the cracks or flaws. One such test method requires the use of finely divided particles of magnetic-iron oxide (magnetite) suspended in kerosene or a similar medium. The particles tend to settle to the bottom, so it is usually necessary to keep the liquid in an oilcan and to shake it well just before application.

In one of the departments of the General Electric Company's Schenectady plant where many small pieces of machined alloy steel—4x½x¼ inch—must be checked, the clumsy and retarding oilcan has been replaced by a "bubble bath" or agitator. This consists of a covered tank to hold the solution, of an outlet tube, and of an air pipe reaching close to the bottom of the tank where the iron oxide normally settles. Low-pressure air is used. There is a conical baffle at the lower end of the pipe, and this helps materially to disperse the air throughout that area and to provide a liquid in which the solids are kept in fairly uniform suspension. The outlet tube is placed a few inches above the bottom of the tank, and this obviates plugging it when not in use.



STRUCTURAL ARRANGEMENT

Cross section of the agitator and worktable. The tank should be made of glass or nonmagnetic metal.

Industrial Notes

It has been suggested that luminous paint be used underground in collieries as a means of preventing accidents in case of failure of lighting systems.

Once American manufacturers were considered the world's worst packers. Today they are perhaps the best. They are actually packing Army, Navy, and lend-lease equipment in such a way that it can be thrown overboard where waters are too shallow for vessels to dock and swept ashore by the tide without sustaining injury from salt water, exposure, or shock.

Overturning of boom cranes under excessive loads is prevented, it is claimed, by the use of a stability-gauge devised by the General Electric Company. The instrument not only gives the operator a continuous picture of his margin of safety but also stops the crane automatically if the load is too heavy or the boom has moved out too far.

In the emergency kit of aviators is a small and light collapsible vessel that woodsmen, prospectors, contractors, and the like will find handy when it is made commercially available after the war. The container is woven of asbestos cloth held in shape by metal pins and is used for boiling water for tea, for sterilizing wounds, etc.

Those interested in welding, brazing, or silver soldering will find the new Krembs Fluxine Chart helpful. It comes in bulletin form, lists all the common metals and alloys, as well as many of the rarer ones, and indicates the flux that should be used when joining them by different processes. Men engaged in metal-working may obtain a complimentary copy from Krembs & Company, 676 West Ohio Street, Chicago 10, Ill., by writing their request on their company letterheads.

Rohm & Haas Company

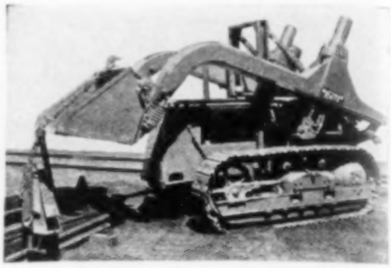
CONFINES SAWDUST

This shield for circular saws was designed in the Methods Engineering Department of the Republic Aviation Corporation. It is made of tough, transparent Plexiglas and protects the operator against eye and head injuries. Although large, it does not hamper him in his work.

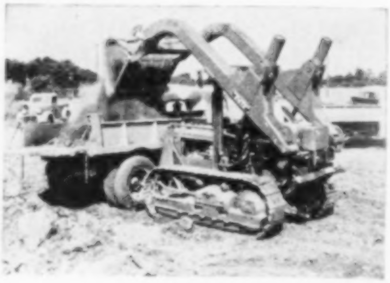
Economy dictates the use of industrial belts until they are in a condition that does not warrant repair or resurfacing. Among the products available for the purpose is So-Lo, which is now being compounded with synthetic rubber. In its new form the material is said to have greater resistance to oil and grease and to be less subject to shrinkage. The material has other applications such as resurfacing metal, wood, and composition pulleys to prevent slippage and wear; insulating switch handles and other electrical devices to safeguard workers; repairing rubber boots and gloves, etc.

The new Vernier Valvactor announced by The Foxboro Company operates on the same principle as the older model but differs from it in the arrangement of the actuating elements. The result is greater ease and range of adjustment, especially in duplexing and sequencing; better snap action for relay service or step sequencing of valves or damper motors; and reversal without change of parts or piping. The improved micropositioner for pneumatic-motor valves is said to insure precise and dependable response, particularly where operating conditions have a tendency to make it uncertain, slow, or unsatisfactory. It is actuated by air-pressure changes as slight as the equivalent of ½ inch of water and can effect a valve-stem movement of as little as 1/1000 inch.

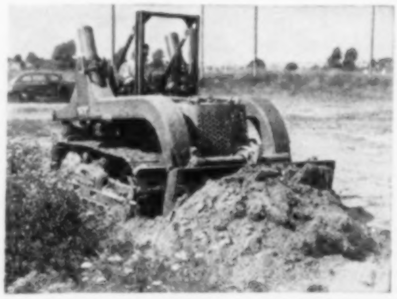
As a result of production in excess of military demands, there is available for civilian use under government release a limited number of Dozershovels designed and manufactured by the Bucyrus-Erie Company for the armed forces. This new unit is a combination tractor-shovel, bulldozer, and crane, permitting change-over in the field from bucket to blade, or *vice versa*, in a few minutes. According to the builder, hydraulic control gives the shovel a down pressure up to 4200 pounds for big pay loads in a short distance of travel, and strong side arms permit lifting them. The same equipment enables the blade to penetrate hard materials easily, to hold the cut, and to handle any dirt-dozing job, while a dumping trip mechanism makes it possible to tip the blade forward and to release the load when dozing uphill. This is an innovation in bulldozers. The traveling height of the unit is 8 feet 1½ inches, which allows working in close quarters and transportation on trailers, thus obviating route-planning to avoid underpasses. Other features are oscillating tracks for stability on uneven ground, high lift for loading trucks, and unobstructed visibility, which lessens operator fatigue, permits accurate dumping, and increases maneuverability.



LIFTING

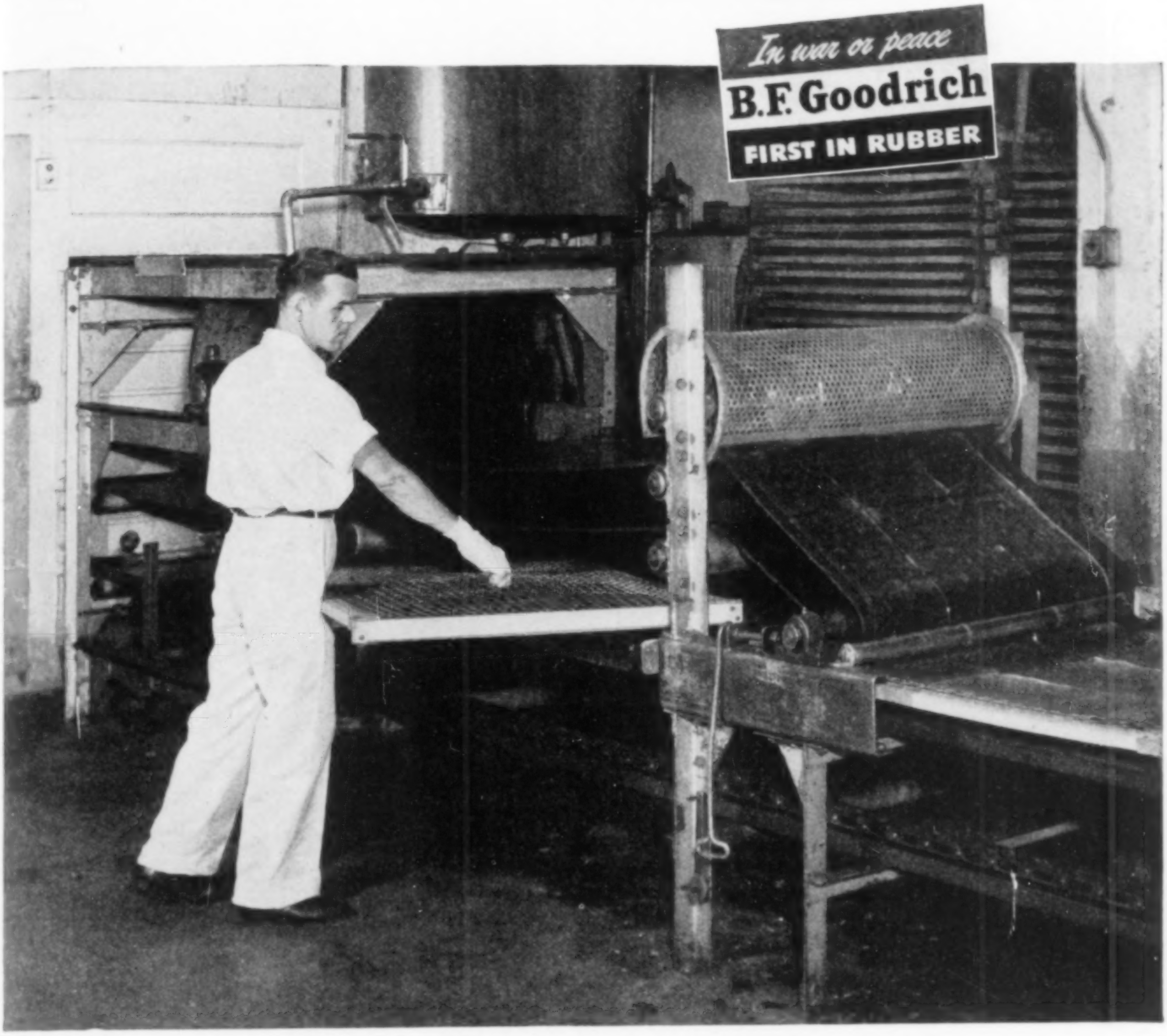


SHOVELING



BULLDOZING

It sounds incongruous, but it is a fact that the Locust Coal Company has a breaker with coal chutes of Carrara glass. The sections, five in number, were formerly made of steel plates that had to be replaced about every three months because of corrosion and wear caused by the sulphur water and the abrasive action of the coal. The chutes carry an average daily load of 100 tons and have been in service since May of 1942. So far they show hardly any sign of deterioration, and there has been no breakage. Carrara glass is a product of the Pittsburgh Plate Glass Company.



Rubber like glass puts gloss on glue

A typical example of B. F. Goodrich improvement in rubber

GLUE is sold to industrial users by the barrel in clear, smooth flakes. To make it clear they used to pour a melted mixture onto glass plates, let it set, then break it off in flakes.

A manufacturer developed a faster, better process, pouring onto a moving rubber belt and slicing off with a moving knife — but the glue was always cloudy. The rubber wasn't smooth enough — and buyers regarded clearness as an indication of quality.

The manufacturer came to B. F. Goodrich. Could rubber be made with a smooth, firm surface, more like the glass plates? The research men not only developed a rubber that left the glue as clear and glossy as before but designed a belt that stands the heat of the glue, has raised edges to keep it from running over and is so uniform in thickness that the knife can cut the glue without touching the belt. It made the new method of glue making a complete success.

B. F. Goodrich research and development work is continuous, and product improvement is a permanent policy. It applies to nearly every kind of rubber or flexible synthetic article used in war or peace. No product is regarded as finished or standardized or too small to bother with. So check with a B. F. Goodrich distributor before you buy. Don't decide any product you may be using is the best to be had until you've found out what B. F. Goodrich may have done in recent months to improve it. *The B. F. Goodrich Company, Industrial Products Division, Akron, O.*

B.F. Goodrich

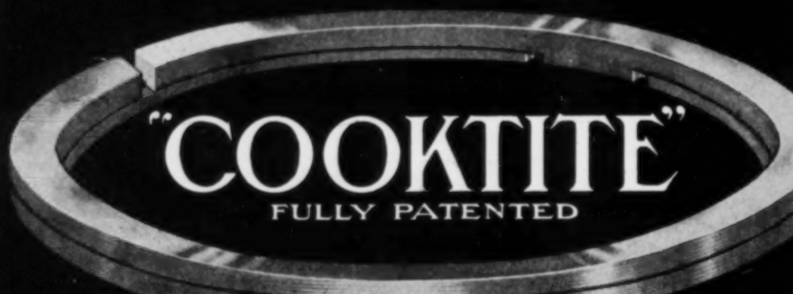
RUBBER *and* SYNTHETIC *products*

Sealing
Pressures

Since
1888

STOP COMPRESSION LOSSES

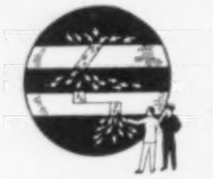
INSTALL



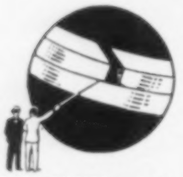
"COOKTITE"
FULLY PATENTED

TWO PIECE PISTON RINGS

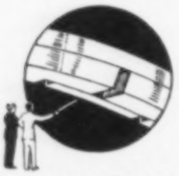
COMPARE
ADVANTAGES OF THIS UNIQUE PISTON RING



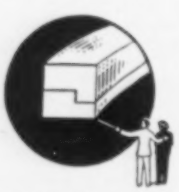
Compression leaks through the joint openings in ordinary rings.



The COOKTITE cylinder seal eliminates compression blow-by.



The groove is also sealed by the COOKTITE patented construction.

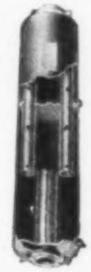
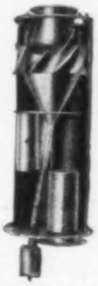
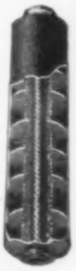
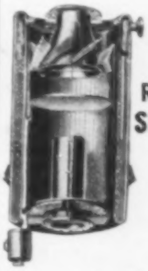
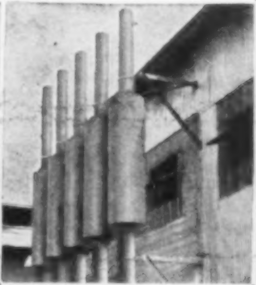
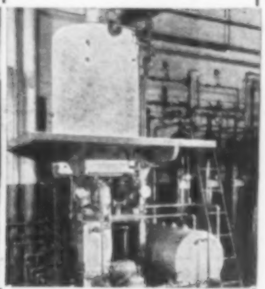


Full depth radial strength and single ring groove bearing are exclusive features.

ANY Diesel is a more efficient engine if its pistons are sealed against compression losses. Keep this fact in mind—it is particularly important right now with the attention of all operators focused, as it is today, on reducing operating and maintenance costs. ● By compression loss is meant that insidious escape of pressure through the joint openings of ordinary rings with each engine stroke in such a matter-of-fact way as to miss a busy engineer's attention. It may be ever so small in the case of a new engine but rapidly increases and takes on serious aspects as the joint clearances enlarge with ring and cylinder wear. Not only is there a waste of fuel but the escaping hot gas absorbs the essential oil film on the cylinder wall causing excessive wear. ● You can stop these compression losses by replacing several of the ordinary rings with COOKTITE Sealing Rings. ● Unquestionably the leader in its class, the COOKTITE Ring is the product of a manufacturer having a background of 56 years of faithful service in the industrial engine field. In combination with COOK'S GRAPHITIC IRON Plain Rings they constitute the finest in piston ring equipment. ● When you need piston rings, we are ready to serve you. When you have a ring problem, our 56 years experience is at your call.

C. LEE COOK MANUFACTURING CO.—Incorporated, Louisville, Kentucky. Branches and Representatives—Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, Montreal, New Orleans, New York, Portland, Ore., San Francisco, Seattle, Tulsa.

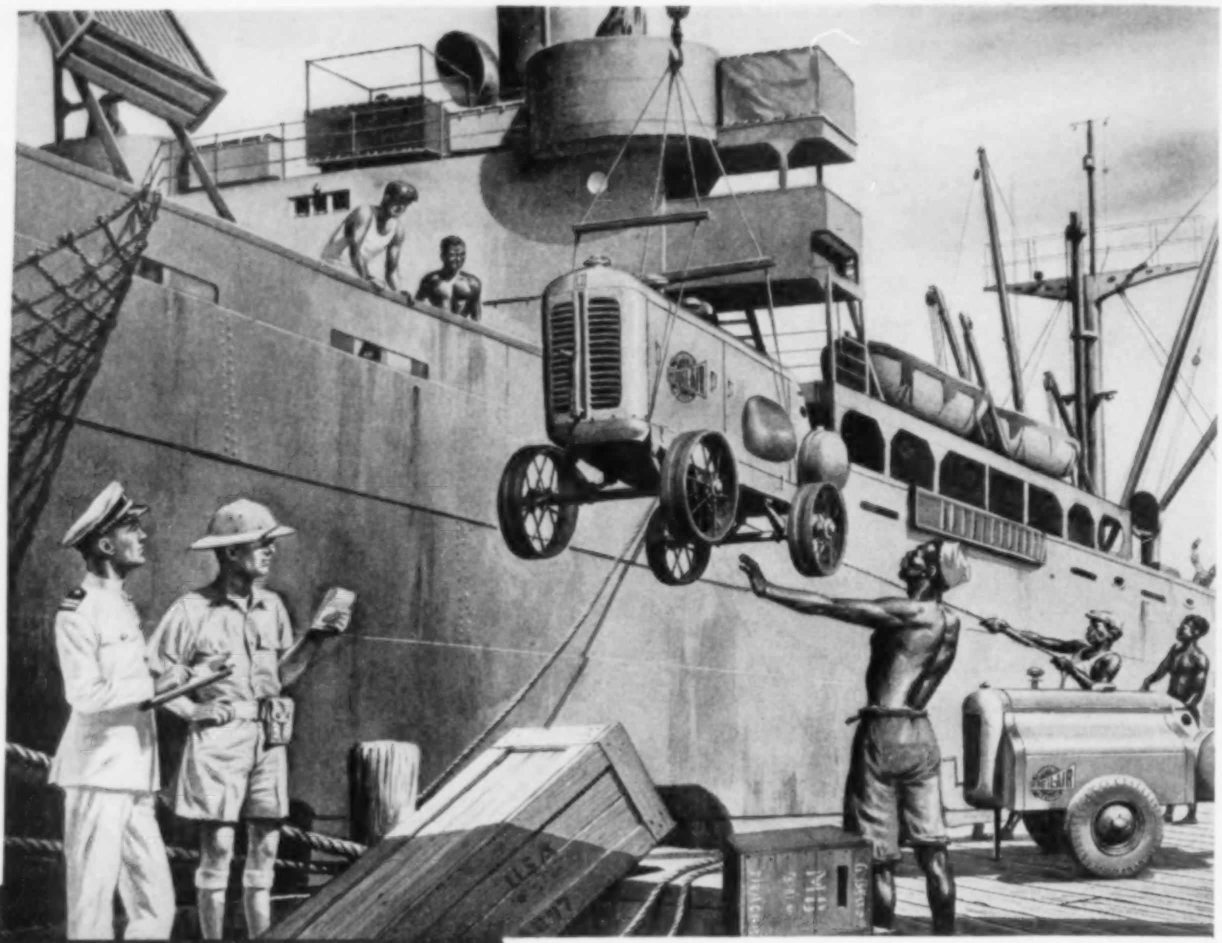
COOK'S GRAPHITIC IRON
Piston Rings

PRODUCT	 EXHAUST AND INTAKE SILENCERS	 SPARK ARRESTOR SILENCERS	 STEAM BLOW-OFF SILENCERS	 HEAT RECOVERY SILENCERS
USE				
DESCRIPTION	● These Maxim Silencers are designed to silence the exhaust or intake of internal combustion engines, steam engine exhausts, air compressor intakes, vacuum pump discharge and the intake or discharge of blowers of the positive pressure type. Wide choice of models to fit varying space and silencing requirements.	● Maxim Spark Arrestor Silencers effectively silence exhaust noise and in addition provide for 100% trapping of all sparks and embers which might come from the exhaust. Of obvious value in marine use, these Spark Arrestors are also applicable to industrial use where a fire hazard exists.	● These silencers were developed for use on installations involving the discharge of high velocity steam, air or gas to atmosphere. Used for steam blow-off, safety valve discharges, etc. Silencers shown above installed on high velocity steam exhaust have a total capacity of 135,000 lbs. per hour.	● Maxim Heat Recovery Silencers combine efficient silencing of engine exhaust with spark arresting (where necessary) and with the recovery of waste exhaust heat to produce steam or hot water. Highly efficient heat transfer . . . automatic controls . . . may be run wet or dry.
LITERATURE	**BULLETINS:** **D125, D127, D101, D37, D16.** 	**BULLETINS:** **D105 and D33.** 	**BULLETIN:** **D111.** 	**BULLETINS:** **WH100, WH101 and WH103.**

THE MAXIM SILENCER CO. • 85 Homestead Ave., Hartford, Conn.

ARMY E NAVY

MAXIM



IN THE HOLD . . . ON THE JOB . . .

ALWAYS SAVING WITH MOBIL-AIR

These machines are used by the fighting forces to build and repair roads, bridges, bases, landing fields, gun emplacements, pillboxes, tank traps, fuel storage . . . to save time and money.

Out of the hold where every inch and ounce of cargo is vital to victory, ship after ship has swung Ingersoll-Rand MOBIL-AIR Compressors and air tools onto century-old docks and strange lands the world over . . . serving practically every combat and supply zone of the United Nations.

MOBIL-AIR Compressors were designed for peacetime operations, yet for jobs so tough that they go to battle now with no change except their coat of war paint.

But, because of new features incorporated before Pearl Harbor, MOBIL-AIR Compressors now occupy less space, weigh less, and *use much less fuel.* These save priceless cargo space and weight in the freighters that transport the machines, and reduce the gasoline that must be carried over there to do the job. Such features will be equally valuable in the reconstruction period after victory has been won.

Ingersoll-Rand
11 Broadway, New York 4, N. Y.

2-307

COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES • CONDENSERS • CENTRIFUGAL PUMPS

THE CORROSION CONDITIONS:
Mild Solutions at Temperatures to 1100° F.
THE APPROVED STEEL CASTINGS ALLOY:
Lebanon CIRCLE L 10

LEBANON Ⓛ 10 is the "standout" for handling moderately corrosive solutions over a broad range of applications and at temperatures to 1100° F. Strength and yield point are notably high . . . creep is exceptionally low.

This alloy may be welded by the electric arc or the acetylene method with welding rod of similar basic composition.

Lebanon Ⓛ 10 is recommended for heat exchangers, return bends, flow line headers, flow line header plugs, flow line header yokes, flanges, pipe fittings, valve bodies, valve trim, oil pump impellors, oil pump diffuser rings, oil pump casings and condenser fittings.

For its intended functions, Lebanon Ⓛ 10 is an ever dependable specification. Find out where and how it fits into your picture . . . write today for further information.

LEBANON STEEL FOUNDRY, LEBANON, PA.
ORIGINAL AMERICAN LICENSEE GEORGE FISCHER (SWISS CHAMOTTE) METHOD

LEBANON Ⓛ 10

ANALYSIS Carbon .30 Max. Chromium 4.00 to 6.50 Molybdenum .40 to .65

MINIMUM PHYSICAL PROPERTIES

(Room Temperature)

Tensile Strength, PSI	90000
Yield Point, PSI	60000
Elongation in 2"	18%
Reduction of Area	30%
Brinell Hardness	175
Bend Test (when required)	90%

ALLOWABLE STRESS VALUES*

(Castings for Pressure Piping)

Temperature	Oil, PSI	Power, PSI
650° F	15500	12000
700° F	15250	12000
800° F	14750	11800
900° F	12500	10000
1000° F	7300	5850
1100° F	2750	

*American Standards Association, 1942

LEBANON CIRCLE L *Stainless and Special Alloy* **STEEL CASTINGS**

FIT THE VALVE TO THE SERVICE

WALWORTH

Steeliron

LUBRICATED PLUG VALVES

No. 1796 — SCREWED
No. 1797F — FLANGED

No.1796
3
WALWORTH
CLASS
125-C.I.

No. 1796

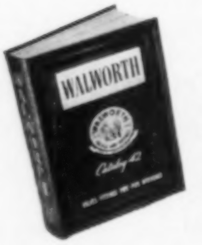
for working pressures up to 175 lbs. O.W.G.

This Walworth lubricated plug valve meets a wide range of requirements, and also helps to conserve critical copper. Made of close-grained, high strength cast iron, it uses insoluble lubricants to assure tight-sealing, easy operation, and resistance to corrosion and wear.

When the lubricant screw is turned down, lubricant is forced under pressure through a system of grooves around the ports to the bottom of the plug. This seals the ports against leakage, and reduces friction between plug and body. The lubricant also protects plug and body against contact with line fluid, thus combatting corrosion.

Walworth Lubricated Plug Valves are particularly adaptable for the handling of gritty solutions and many other destructive erosive and corrosive industrial and chemical solutions. They are made in sizes from 1″ to 4″. Write for circular No. 91.

SEND FOR CATALOG



You'll find pertinent information on Walworth's complete line of valves, fittings, pipe, and pipe wrenches in the new Walworth Catalog 42. Included are 78 pages of practical engineering data that simplify valve selection and make piping layouts easier. Write, on business stationery, for your free copy. Address: Walworth Company, 60 East 42nd Street, New York 17, N. Y. Department 217.

BOSTON WORKS
KEWANEE WORKS

WALWORTH
valves AND fittings

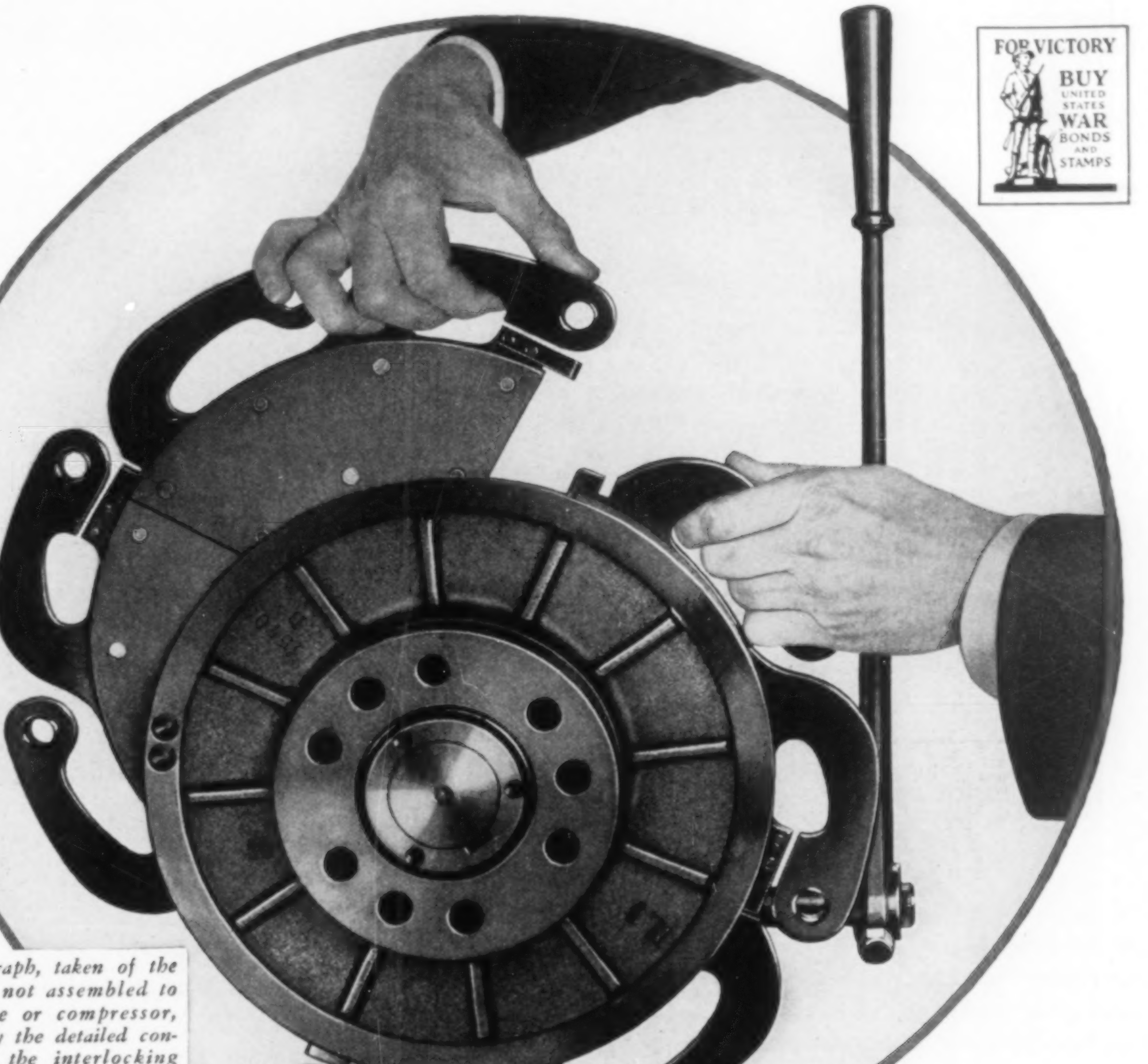
WALWORTH VALVES AND FITTINGS ESTABLISHED 1842

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

FLEX-DISC CLUTCHES

Used on the entire line of I-R *Mobil-Air* Compressors, have a time proven drive disc with flexible fingers solidly bolted to the fly wheel. When the friction facings become worn these drive discs, which are quickly detachable in segments, may be removed and relined or replaced without disconnecting the engine from the compressor.

FOR VICTORY
BUY
UNITED STATES
WAR
BONDS
AND
STAMPS



This photograph, taken of the clutch only, not assembled to either engine or compressor, shows clearly the detailed construction of the interlocking drive disc segments.

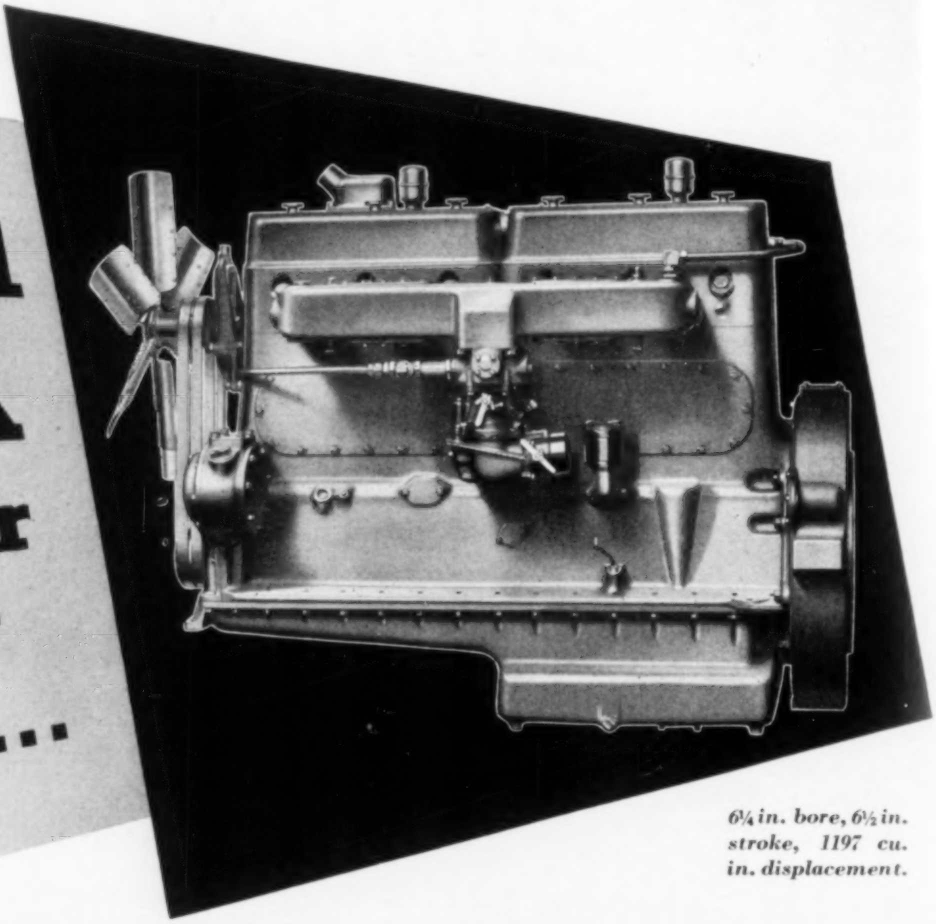
U. S. Patent Nos. 2,177,362; 2,259,461 and 2,303,201

NOTE: To save vital materials this advertisement will be used for "the duration."

C. M. EASON, INDUSTRIAL CLUTCH CO.

Waukesha Wisconsin

Model WAK Super Duty Six...



6¼ in. bore, 6½ in. stroke, 1197 cu. in. displacement.

WAUKESHA ENGINES

deliver maximum power... burn gasoline or butane

● This is *the* engine for the super trucks and busses of tomorrow—oil field service—and for pumps, generators and other mobile industrial equipment. With every modern feature of design and construction—it delivers more than 225 hp. at 1600 r.p.m.—burns gasoline or butane—and maintenance is easy and economical.

The Super Duty Six lives up to its name. Built to take it . . . and take it . . . and still be able to dish it out. Rugged . . . to the last fine detail . . . from oil pan to head.

Crankcase and cylinder frame are cast as one unit . . . so braced as to give the entire structure *remarkable rigidity*. Riding in its seven hefty, husky, four-inch bearings, the heat-treated steel crankshaft is positively aligned . . . stays that way.

When servicing a Super Duty Six, you do it the easy way—that's another Waukesha construction advantage. Valve grinding is simplified. Since it's an overhead valve engine, you remove the heads and do it where it's most convenient. Each cylinder is a wet type sleeve. Press it from the main case and replace it—it's that easy.

Include this Waukesha Engine in making your post-war plans. Write for Bulletin 1138.

MORE POWER FOR VICTORY

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS. • NEW YORK • TULSA • LOS ANGELES

The Cost Is What You Make It

★ Air is a peculiar industrial commodity. The poorer its quality, and the less you get—the more it costs.

First, you pay for air with every dollar invested in compressors and their operation and maintenance.

Then you find that dirty air is the most expensive kind, because it raises general hob with your equipment, and sends maintenance costs sky-high.

But clean air can be expensive, too. That happens when air cleaning devices obstruct intake air and reduce compressor output.

The most economical air is clean—to minimize maintenance costs. It is filtered with little restriction—to maintain rated compressor capacities. Air-Maze Oil Bath filters are designed to give you this kind of low-cost air *because their high efficiency and low restriction remain constant* due to automatic oil-washing action.

That's a statement we'll be glad to prove in your own plant.

★

STOP NOISE, TOO!

Intake noise can be effectively reduced with Air-Maze filter silencers. Oil bath type filter, with automatic oil-washing action, is combined with specially designed acoustical chamber. Write for catalog sheet.

AIR-MAZE CORPORATION • *Engineers and Manufacturers* • CLEVELAND 5, OHIO

Representatives in Principal Cities • *In Canada:* Williams & Wilson, Ltd., Montreal, Quebec, Toronto, Windsor

AIR-MAZE

SPECIALISTS IN AIR FILTRATION

SIX REMINDERS *on the* CARE of DRILL STEEL

NOWADAYS it's just common sense to get every bit of service out of a piece of hollow drill steel, whether it's Bethlehem Superior or another make. The following suggestions are probably familiar to most drill-steel users. We publish them as reminders, which if used should prove helpful:

1. Do not use drills with dull bits. Dull bits not only slow down the speed of drilling, but build up fatigue, resulting in premature failure of the drills.

2. Be sure the shank ends of drills are true, and at right angles to the axis of the bar. If shank ends are not cut off square, the hammer will strike on one side of the drill. Excessive strains and vibrations will be set up which will injure both the drill steel and, eventually, the hammer too.

3. Be sure the shank of the drill is full size and that the front head bushing of the hammer is not unduly worn. Excessive play at this point will permit the drill to whip, thus multiplying the stresses in the rod and hastening fatigue failure.

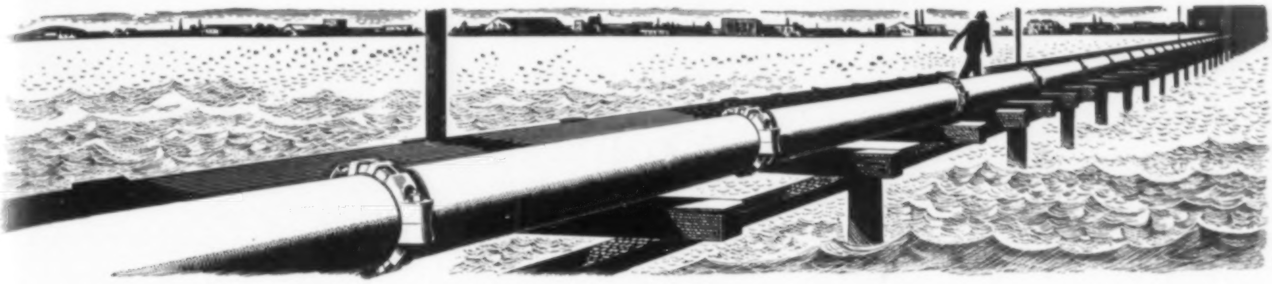
4. Keep the hole through the drill wide open at all times to permit free circulation of air or water.

5. When a drill sticks in the hole and you must strike it to get it loose, be careful not to nick the drill rod. Nicks provide a concentration point for fatigue stresses, and are often the cause of premature failure.

6. Do not leave drill steel where it can be attacked by corrosive mine water or other corrosive agents. The pits resulting from corrosion often lead to premature failure.

BETHLEHEM SUPERIOR HOLLOW DRILL STEEL

BETHLEHEM STEEL



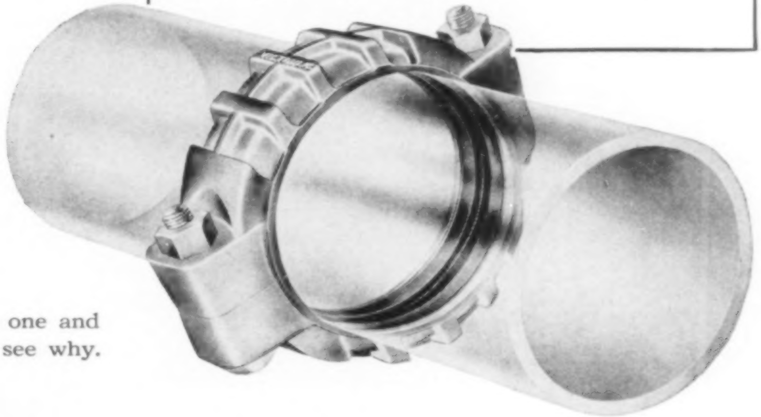
ENGINEERING NIGHTMARE

THE PROBLEM: What to do about a sea-going pipe line on a pier support that waded out into deep water for some 2,000 feet from shore . . . the entire length of pipe being subject to a good deal of movement from wind and water.

THE ANSWER: To install Victaulic Couplings.

SAYS THE PRESIDENT, I. B. Delcher, of The North American Trading and Import Company—"Over a period of 18 years, these couplings not only took care of the movement of the line but obviated the necessity for expansion joints, prevented all leaks and to our mind performed a service that no other joint is capable of." (P. S.—North American as a result installed a second Victaulic-coupled line alongside of the original). Take a look at the advantages of the one and only genuine Victaulic Coupling and you'll see why.

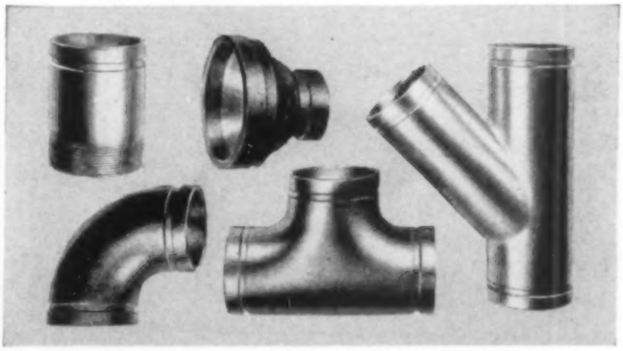
1. **Fast Self-Aligning permits angular deflection!**
2. **Leak-tight, self-sealing under pressure or vacuum!**
3. **Positive mechanical lock of pipe lengths!**
4. **Every joint is a pipe union!**
5. **Every joint an expansion joint!**
6. **Available for all pipe sizes 3/4" through 60"!**



●

SPECIAL VICTAULIC ADVANTAGES FOR INDUSTRIAL USERS!

- ★ **Can be installed faster and with less labor than any other method!**
- ★ **Lower installation costs . . . unskilled labor can do the job.**
- ★ **No expensive equipment needed . . . one small wrench is the only tool required.**
- ★ **Substantial savings in space and weight.**
- ★ **Temporary lines can be salvaged 100 percent. Maintenance is nil!**



VICTAULIC FULL-FLOW FITTINGS eliminate the tedious work of ordinary pipe fitting. Long easy sweeps and smooth true-circular walls reduce friction losses. A real contribution to speed and ease of installation and greater efficiency in conducting fluids and gases in pipe systems!

BUY MORE WAR BONDS

VICTAULIC

Reg. U. S. Pat. Off.

SELF-ALIGNING PIPE COUPLINGS AND FULL-FLOW FITTINGS

Copyright 1944 by Victaulic Co. of America

Ready soon . . . a new easy-to-use Victaulic Catalog and Engineering Manual. If you haven't already reserved your copy, do so now.

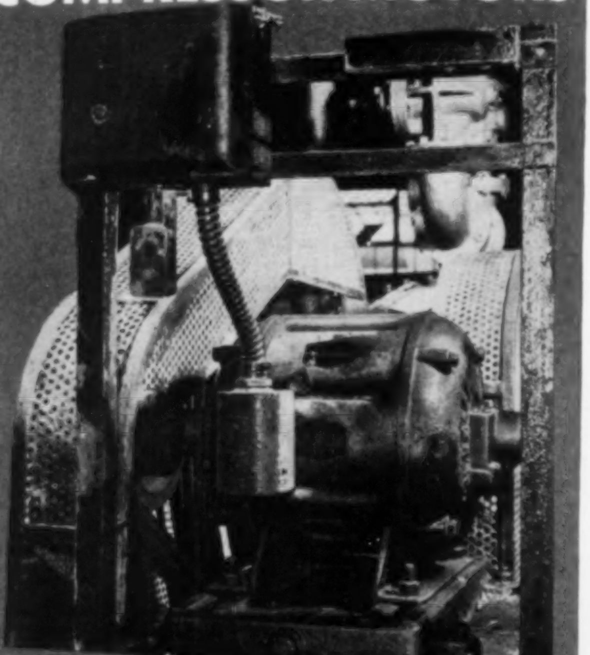
*Name*________________________________

*Firm*________________________________

*Address*______________________________

Mail to nearest address: VICTAULIC COMPANY OF AMERICA, 30 Rockefeller Plaza, New York 20, N. Y.; Victaulic Inc., 727 West 7th St., Los Angeles 14, California; Victaulic Co. of Canada, Ltd., 200 Bay St., Toronto. 4-F

Wagner
COMPRESSOR MOTORS



For continuous and efficient, dependable service!

THE precision-building skill and experience gained by Wagner in more than half a century of producing dependable motors is reflected in the reliable performance of thousands of compressors motorized with Wagner motors.

Wagner compressor motors embody the very latest improvements in motor design which contribute toward such essentials as simplicity, ruggedness, and dependability.

If you need motors to drive compressors used in producing war equipment—specify Wagner compressor motors.

MOTORS
TRANSFORMERS
UNIT SUBSTATIONS
INDUSTRIAL BRAKES
BRAKE LINING

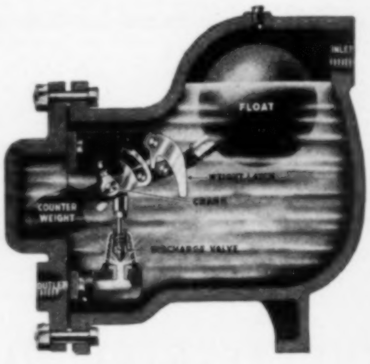
Write **FOR BULLETINS**

Bulletins MU-182 and MU-183 describe and illustrate the complete line of Wagner motors—a motor for every purpose.

M44-4

Wagner Electric Corporation
ESTABLISHED 1891
6418 Plymouth Avenue, St. Louis 14, Mo., U. S. A.
ELECTRICAL AND AUTOMOTIVE PRODUCTS

★
Nicholson Model "JR" Compressed Air Trap
★

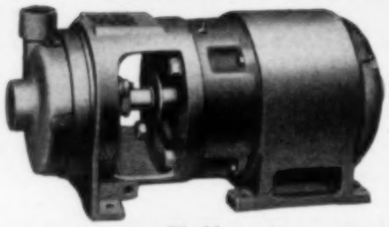


THIS TRAP
INCREASES THE EFFICIENCY OF PNEUMATIC TOOLS

NICHOLSON "Model JR" Compressed Air Traps are specially designed to provide long, trouble-free service in automatically draining air tanks, separators, receivers, after-coolers, etc. Water-sealed discharge valve, welded stainless steel float. Large capacity, pressures to 200 pounds. Intermittent discharge. Bulletin No. 341.

W. H. NICHOLSON & CO.
180 OREGON ST., WILKES-BARRE, PA.
Valves ★ Traps ★ Steam Specialties

PUMPS



The Motorpump

A propeller pump

1 TO 100,000
GALS. PER MIN.

There is an Ingersoll-Rand pump to suit every need from units so small that you can hold them in your hand to units that will supply the entire daily requirements of a large town. There are also special units to meet the requirements of particularly industries such as refineries, paper mills, machine tool manufacturers, etc. Ask the Ingersoll-Rand branch near you for recommendations on a unit to fit your needs.

10-253

Ingersoll-Rand
CAMERON PUMP DIVISION
11 Broadway, New York, N. Y.

Madison-Kipp
Fresh Oil

FED UNDER PRESSURE BY THE MEASURED DROP

The Most Dependable Method of Lubrication Ever Developed

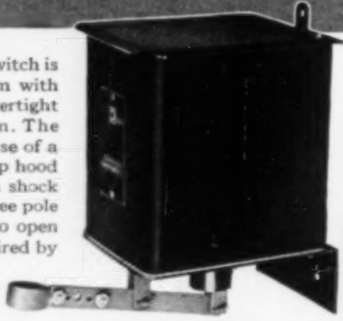
There are Madison-Kipp lubricator models for every Fresh Oil application. There are 6 models and each can be varied to suit the requirements in drive type and location, in the number of feed outlets, rate of feed and pumping pressure. Madison-Kipp specializes in original standard equipment lubricators. When you buy new machinery it will pay you to specify Madison-Kipp . . . the most dependable method of lubrication ever developed. Madison-Kipp Corporation, 202 Waubesa Street, Madison 4, Wisconsin.

MADISON-KIPP CORPORATION, Madison 4, Wis.

Sole Agent in England: Wm. Coulthard & Co., Ltd., Carlisle

Marine FLOAT SWITCH

DRIPPROOF AND WATERTIGHT
HIGH SHOCK CONTACT BLOCK
TWO OR THREE POLE
CLASS 9036 • TYPE AW-H



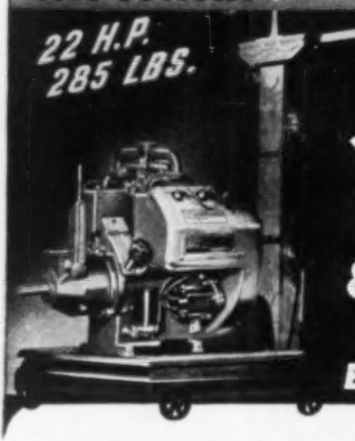
● The class 9036 type AW-H float switch is built for Marine Service to conform with requirements for a dripproof and watertight device of shockproof construction. The switch differs from standard in the use of a special sheet steel enclosure and drip hood with gasket seal and a special high shock bakelite contact block of two or three pole form. The switch can be arranged to open or close on rise in liquid level as required by application. Mounting is three point by means of bracket flange and foot, as illustrated. **Write for Bulletin 563.**

ELECTRICAL RATINGS

Voltage	Single Phase A. C.	Polyphase A. C.	D. C.
110V.	2 H.P.	3 H.P.	1 H.P.
220V.	3 H.P.	5 H.P.	1 H.P.
440-550	5 H.P.	5 H.P.	.....
32V.	.....	.....	½ H.P.

REGULATOR DIVISION
SQUARE D COMPANY
DETROIT • MICHIGAN

WISCONSIN *Air-Cooled* ENGINES



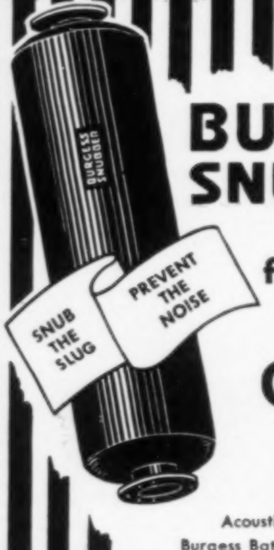
Check for
WEIGHT & POWER
ON YOUR EQUIPMENT

As a built-in power unit on portable or mobile equipment, you'll have to look a long time before you can out-point this Model VE-4, V-type, 4-cylinder, Wisconsin Air-Cooled Engine.

This husky heavy-duty "lightweight" checks in at 285 lbs. and delivers 22 hp. at 2600 rpm. Other Wisconsin Air-Cooled engines (from 1 to 31 hp.) are equally adaptable to a great variety of applications where lightweight is wanted, without sacrificing heavy-duty serviceability.

MOST POWER Per POUND

WISCONSIN MOTOR
Corporation
MILWAUKEE, WISCONSIN, U. S. A.
World's Largest Builders of Heavy-Duty Air-Cooled Engines



BURGESS SNUBBERS

for

Quiet Compressor Intakes

Acoustic Division
Burgess Battery Company
2823-I West Roscoe Street
Chicago 18, Illinois

An Audel Guide!
PUMPS
HYDRAULICS
AIR
COMPRESSORS
T. D. GRAHAM
A PRACTICAL TREATISE

PUMPS-HYDRAULICS-AIR COMPRESSORS

JUST OUT! 3 BOOKS IN ONE—OVER 1650 PAGES, 1654 ILLUSTRATIONS, WITH QUESTIONS AND ANSWERS. COMPLETE PRACTICAL CONCISE INFORMATION FOR ALL ENGINEERS AND OPERATORS.

***PART 1*—PUMPS—850 Pages:** All types—Centrifugal—Rotary—Reciprocating Pumps: Their Theory, Construction, Operation and Calculations. Air and Vacuum Chambers—Power Pumps—Air Pumps—Jet Condensers—Surface Condensers—Condenser Auxiliaries—Condenser Operation—Calculations—Cooling Ponds—Cooling Towers—Water Supply—Hydraulic Rams—Special Service Pumps—Automotive Fire Pumps—Dredges—Codes. 942 Illustrations.

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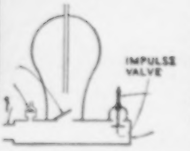

***PART 3*—AIR COMPRESSORS—406 Pages:** Compression of Air—Compressor Classification—Parts, Types—Inter and After Coolers—Regulating Devices—Installation—Lubrication—Operation—Maintenance—Blowers—Super-Chargers—Pneumatic Hand Tools—Ready Reference Index and Tables. 402 Illustrations.

Free Examination

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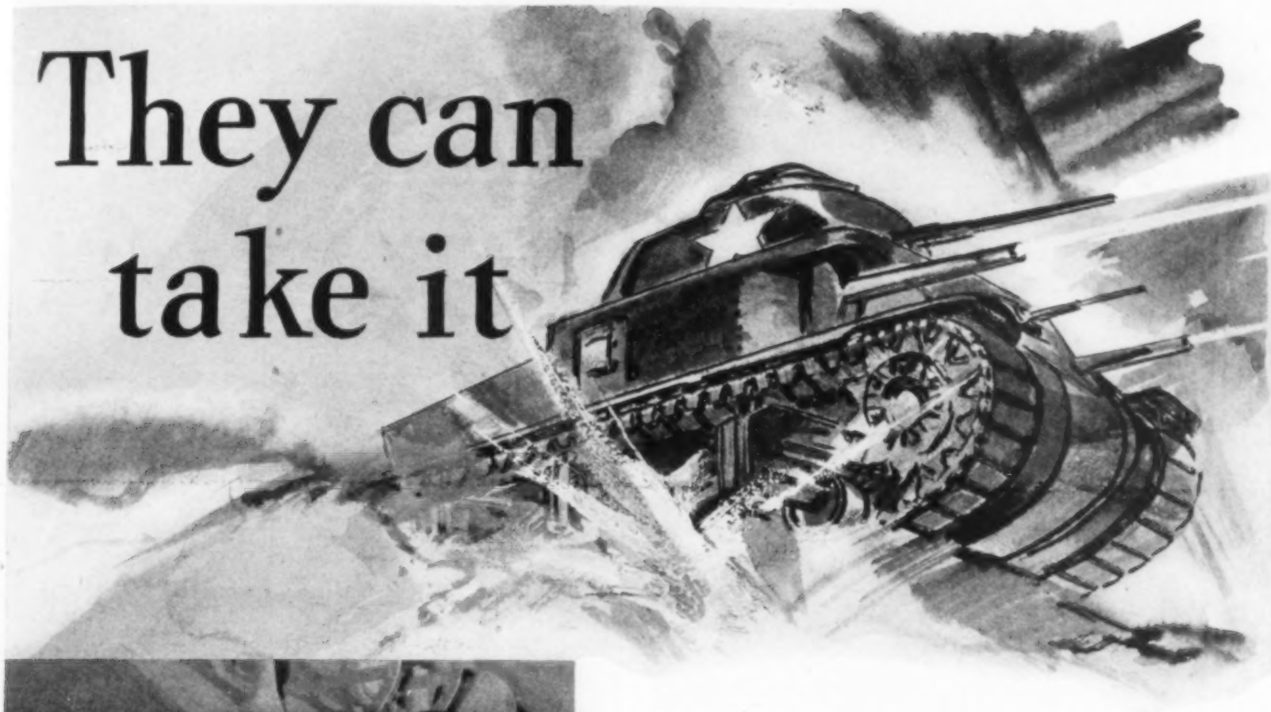
AUDEL, Publishers, 49 West 23 St., New York 10, N. Y.
Send postpaid AUDELS PUMPS, HYDRAULICS, AIR COMPRESSORS ($4). If I decide to keep it, I will send you $1 within 7 days; then remit $1 monthly until purchase price of $4 is paid. Otherwise, I will return it promptly.

Name....................................
Address....................................
Occupation....................................
Employed by.......................... C.A.M.

They can take it



Size 534 Ingersoll-Rand Impact Wrench running nuts on one-inch bolts during installation of drive sprocket on an M-4 tank.

Tanks must be durable and tough without sacrificing maneuverability and power. The tools that help build these giants must measure up to the same standards.

Yes—AIR tools can take it! The simple design of AIR tools permits a durable, lightweight unit that gives reliable service and longer tool life. For instance . . . air motors can be instantly started, stopped, or reversed . . . overloading will merely stall the tool with no injury to the air motor or other vital parts . . . many air tools do not require complicated gearing and seldom need multi-step reductions . . . air tools run cool . . . the exhaust supplies ventilation when the operator is working in hot, dusty atmosphere . . . air tools are protected from dirt.

Freedom from breakdowns keeps production on the go and naturally lowers maintenance. Choose from the complete line of Ingersoll-Rand AIR tools. And . . . to operate these tools and furnish air for countless other uses, Ingersoll-Rand offers ever size and type of compressor.

Uninterrupted Service Assures More Production

Ingersoll-Rand

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COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • CENTRIFUGAL PUMPS • CONDENSERS • OIL AND GAS ENGINES

Official U. S. Navy Photo

Violent Sea Action!

"Sure Kill" of a Nazi sub is depicted in this remarkable close-up of a U.S. bomber attack against a Nazi wolf pack. One bare-legged Nazi stands in awe as another ducks. Arrow points to depth bomb about to hit water.

Buy more War Bonds and help kill the enemy wolves!

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company
of Canada Ltd., Montreal, Que.

Photo at left shows a set of Garlock CHEVRON packing and a single Chevron ring. Chevron is one of the many Garlock packings being supplied to the U.S. Armed Forces and war industries.

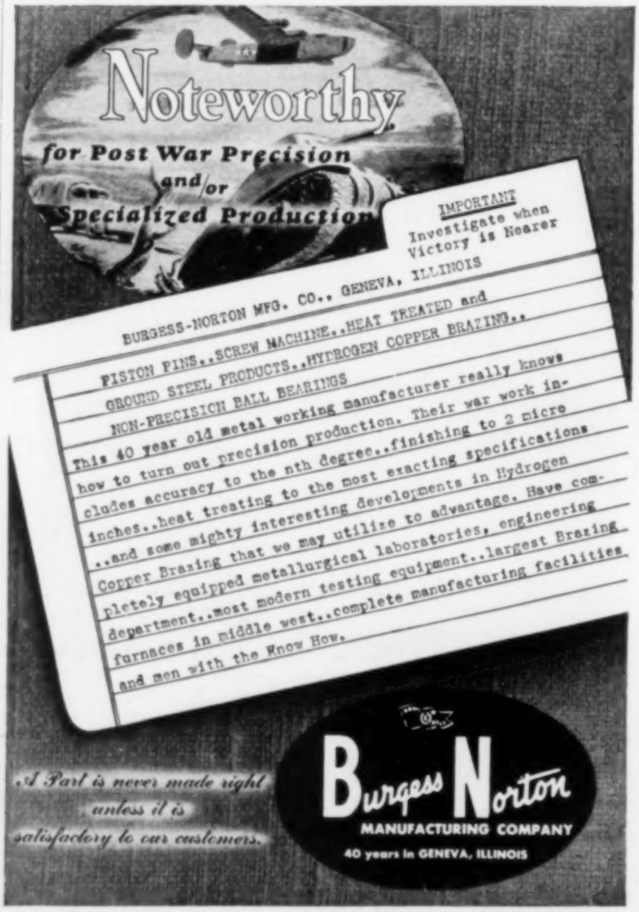
GARLOCK

R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors . . . installed as replacements on thousands of compressors in all parts of the U. S. A. and overseas. The R-C valve—positive in action—cannot chatter . . . it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.

R. C. PILOT VALVE
STRAINER TYPE

R. CONRADER CO.
1207 FRENCH STREET - ERIE, PA.
PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders



Noteworthy
for Post War Precision and/or Specialized Production

IMPORTANT
Investigate when
Victory is Nearer

BURGESS-NORTON MFG. CO., GENEVA, ILLINOIS

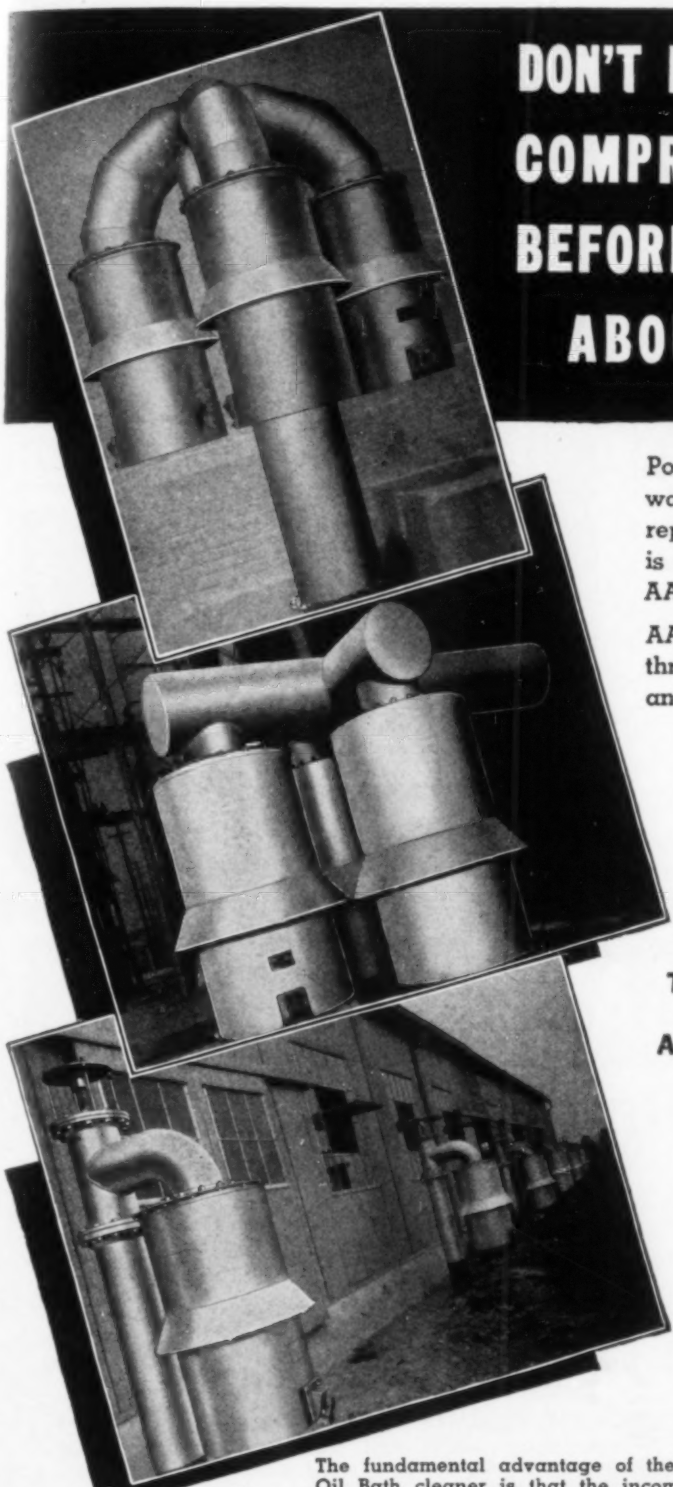
PISTON PINS..SCREW MACHINE..HEAT TREATED and
GROUND STEEL PRODUCTS..HYDROGEN COPPER BRAZING..
NON-PRECISION BALL BEARINGS

This 40 year old metal working manufacturer really knows how to turn out precision production. Their war work includes accuracy to the nth degree..finishing to 2 micro inches..heat treating to the most exacting specifications ..and some mighty interesting developments in Hydrogen Copper Brazing that we may utilize to advantage. Have completely equipped metallurgical laboratories, engineering department..most modern testing equipment..largest Brazing furnaces in middle west..complete manufacturing facilities and men with the Know How.

A Part is never made right unless it is satisfactory to our customers.

Burgess Norton
MANUFACTURING COMPANY
40 years in GENEVA, ILLINOIS

DON'T MAKE YOUR ENGINES OR COMPRESSORS *Call Quits* BEFORE YOU DO SOMETHING ABOUT AIR CLEANERS!

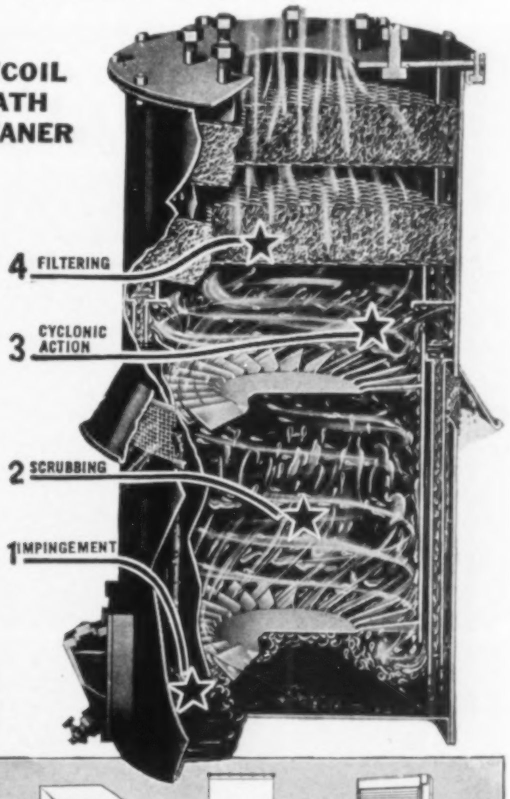


Power plants are too precious and important to the war effort today, to risk unnecessary shut downs for repairs—especially when such a small investment as is needed to equip engines and compressors with AAF air cleaners will eliminate most of the causes.

AAF air intake filters are in use on power equipment throughout the nation—protecting valves, cylinders and pistons against excessive wear due to dust and grit. Bulletins describing the entire line of AAF filters are available on request.

Shown on this page are photographs of several Cycoil installations. This air cleaner is outstanding because of its unique 4-way cleaning principle described below. Ask for Bulletin No. 130D.

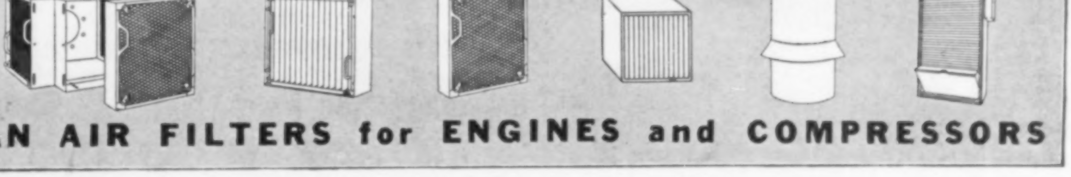
THE CYCOIL OIL BATH AIR CLEANER



The fundamental advantage of the Cycoil Oil Bath cleaner is that the incoming air stream picks up an unusually large quantity of oil which is thoroughly mixed with the air (causing a scrubbing or precleaning action), and then thrown out by centrifugal action before the air stream enters the filter cell. This results in reducing the dust load on the filter cell and insuring continued self-cleaning action.

AMERICAN AIR FILTER CO. INC.
402 Central Avenue, Louisville, Kentucky
In Canada: Darling Bros., Ltd., Montreal, P. Q.

AAF



AMERICAN AIR FILTERS for ENGINES and COMPRESSORS

NO OTHER COUPLING
gives all its operating advantages

WALDRON GEAR TYPE COUPLING

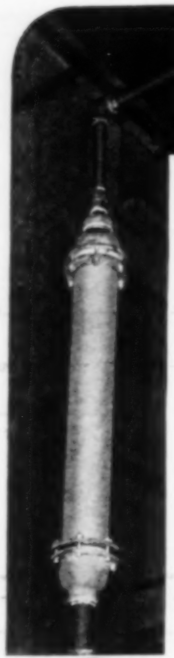
1. Positive seal protects against dust and oil leakage.
2. Hubs and Cover Sleeves are Heat Treated Forgings.
3. All metal contact parts constantly lubricated.
4. Longer lining up surface of hubs.
5. Cover sleeves function as single rigid unit.

Our Catalog 56 gives tables of Service Factors, Sizes and Ratings. Write for copy.

Although war work needs receive our first attention, we invite your inquiry.

JOHN WALDRON CORP.
NEW BRUNSWICK, N. J.

Removes 99% plus of water, dirt and oil from compressed air



THE unusual efficiency of the Johnson-Gast Separator arises from the fact that it combines, in one simple device, the two most effective principles of separation—expansion and change of direction. As the air enters it is allowed to expand, precipitating most of the moisture. Then it passes through the "thousand baffles"—a labyrinth of coarse wire mesh—changing direction of flow many times and surrendering particles of water and dirt at every turn.

In all Johnson-Gast Separating Devices you'll find this same combination of simple design and high efficiency. The After-cooler is frequently installed ahead of the separator to condense all moisture vaporized by heat of the compressor. A typical installation is pictured here. The Oil Absorber is used for services where every final trace of oil must be removed, as in paint spraying.

Write for new bulletin

FOR USE ON STEAM LINES TOO

THE JOHNSON CORPORATION
830 Wood Street, Three Rivers, Michigan

JOHNSON-GAST
SEPARATORS • AFTERCOOLERS • OIL ABSORBERS

GREATER PNEUMATIC EFFICIENCY

WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT

● DriAir separates and automatically ejects the condensed water and oil from compressed air lines, collects pipe scale and rust, delivers clean dry air to tools and other pneumatic equipment. This promotes better lubrication, reduces wear, increases life of tools and produces greater output. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent.

Write for Bulletin DA which fully describes the construction and operation of the DriAir.

IN
OUT
DRIAIR
NEW JERSEY METER CO.
PLAINFIELD N.J.
MADE IN U.S.A.

DriAir may be suspended from overhead piping without any other support.

A typical installation showing DriAir standing on the floor next to the wall.

SEPARATES • COLLECTS • DELIVERS

NEW JERSEY METER COMPANY
PLAINFIELD, NEW JERSEY

"Boys, let's put our heads together and see how much paper and paper board we can save!"

THAT'S the spirit. That's what we've all got to do to lick this problem of getting enough paper and paper board for Army and war-production use.

Every company has got to organize a Paper Conservation Committee and tackle the problem with all the gumption and the brain power at their command.

Paper inventories must be checked with the idea of eliminating peacetime extras. From stationary to board containers, every paper item must be examined to see in what way each company can use less paper.

Functional packaging must be the order of the day.

Sure, you have followed all the government directives on the subject. Even made cuts of your own. But, frankly, that isn't enough. Every time another ship leaves an American port loaded with paper-wrapped war supplies, the problem becomes tougher.

And it's up to you to join with the rest of industry to lick it. The War Advertising Council and the War Production Board have prepared a brief list of suggestions to help you. But you know your own business. You know how you can use less paper. **It's up to YOU!**

TO GET MORE PAPER FOR . . .

- **Blueprints for battleships**
- **"K" ration containers**
- **Signal Corps radio sets**
- **Containers for shells**
- **Gas mask canisters**
- **Disposable gun covers**
- **V-mail envelopes**
- **Blood plasma boxes**

USE LESS PAPER THESE WAYS

- **Eliminate slack fills.**
- **Increase units per case to the maximum practical.**
- **Reduce separators to shoulder height.**
- **Eliminate carton liners if possible.**
- **Eliminate individual cartons wherever possible.**
- **Reduce weight of containers whenever compatible with safety.**
- **Do away with all unnecessary overlapping.**
- **Set up a Paper Conservation Board in your plant.**

This advertisement prepared under the auspices of the War Advertising Council in co-operation with the Office of War Information and the War Production Board.

Let's All Use Less Paper

"Space for this advertisement contributed by Compressed Air Magazine."

motor
BUYING DATA
PRICES
control
BUYING DATA
PRICES
DIMENSIONS
Westinghouse
Westinghouse

Use new Buying Data

TO REDUCE SELECTION AND ORDERING TIME

1/2

simplified

FOR QUICKER SELECTION . . .
EASIER ORDERING . . .
QUICKER DELIVERY . . .

When you need motors and control, consult your new Westinghouse Buying Data. It will help you to select and purchase the proper equipment—in ½ *the time.*

Data, as presented, is striking in its newness. It's easier to read, easier to understand, and easier to use than any offered previously by any manufacturer.

To fit widely varying requirements, this radically new Buying Data is available in two forms:

Motor and Control Loose-Leaf Book. This is for the use of large-scale purchasers and is "tailored" to meet the needs of the individual buyer. Pricing data is always kept up to date by the issuance of new price supplements.

Bound books are suitable for use of the majority of motor and control buyers. They contain prices (correct at time of issue and satisfactory for estimating purposes throughout the books' life), dimensions, application data and descriptions. Books include:

"Motor Buying Data" covering popular types and ratings of motors (up to 100 hp), Gearmotors and M-G sets.

"Control Buying Data" listing a wide variety of controllers and accessories for direct current, single-phase, squirrel-cage, wound rotor motors.

J-90499

HERE'S HOW TO GET THIS NEW BUYING DATA

If you are a buyer of Motors and Control, chances are you have already received this new data by mail.

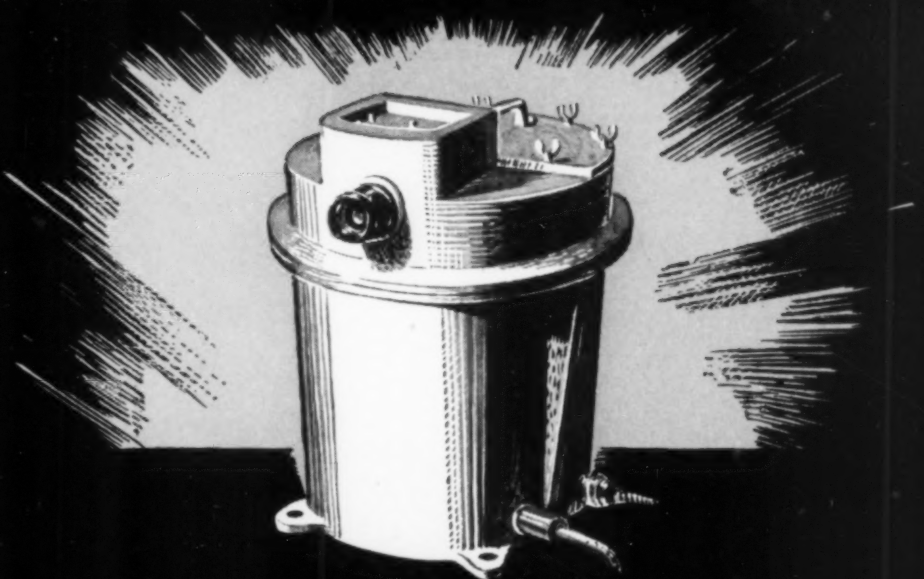
However, if you have not received your copy, write, wire or phone your nearest Westinghouse district office (requests will be filled through district offices only—no mailings from Westinghouse Headquarters at East Pittsburgh). Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Westinghouse MOTORS AND CONTROL

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

WORLD'S FASTEST CAMERA

Charts a Burst of Dynamite



TO CAPTURE pictures of explosives *in action,* Hercules scientists designed and built the world's fastest camera. Operating at exposures as fast as *one ten-millionth of a second,* this amazing instrument photographs dynamite at the very instant of its violent chemical change. Even powerful nitroglycerin's path of detonation, traveling at 250 miles a minute, is "stopped" on film by this shutterless, electrically operated camera.

This study of how explosives behave is only a small part of the intensive research being conducted daily by Hercules. Physicists, x-ray workers, microscopists, and other highly trained specialists are constantly searching for new and valuable knowledge on explosives which may prove helpful to you and your business.

HERCULES EXPLOSIVES

HERCULES POWDER COMPANY
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Ingersoll-Rand
Always ready for action —

TIMKEN BEARING EQUIPPED

Modern maintenance equipment like this Ingersoll-Rand Model KRC-8 Crawl-Air Compressor and Pneumatic Tie Tampers—saves time and cost in keeping railroad track in tip-top condition.

Timken Tapered Roller Bearings are used on the crank shaft of this compressor—as they are in other models of Ingersoll-Rand compressors — to promote maximum smoothness of operation; to prevent crank shaft wear; to protect the crank shaft against radial, thrust and combined loads and hold it in correct and constant alignment. Endurance is increased, compressor life is prolonged and up-keep greatly reduced. The Timken Roller Bearing Company, Canton, Ohio.

To equipment manufacturers: Don't wait to see what will happen after Victory. Prepare for anything by redesigning now and using Timken Bearings.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS